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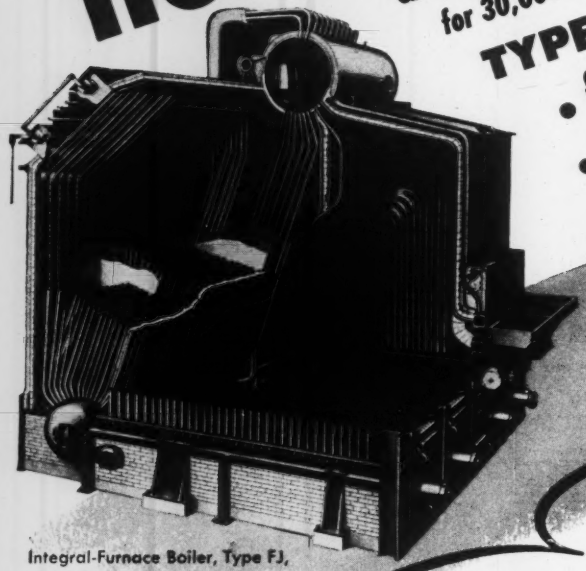
now

an integral-furnace boiler for 30,000–70,000 lb. steam per hr.

TYPE FJ SAVES:

- fuel
- maintenance
- space



Another Example of B&W Engineering for Economy

Integral-Furnace Boiler, Type FJ, arranged for stoker firing.

The Integral-Furnace Boiler, Type FJ is a recent addition to B&W's line of completely coordinated furnace-boiler steam-generators. It makes available a compact, highly efficient installation to answer all process, heating, or power requirements from 30,000 to 70,000 lb. per hr.

Complete fuel-flexibility — coal, oil, or gas, with a choice of alternative firing arrangements — protects the investor against radical changes in fuel prices or conditions of supply. This unit burns a wide variety of fuels — including those of inferior grades and low-temperature ash-fusion characteristics — with high heat-rate efficiency, low maintenance, and minimum stack emission.

It lends itself admirably to pressure-furnace operation with consequent reduction or elimination of ID fans. And where suction operation is used, the low draft-loss design keeps ID requirements to a minimum.

Unusually wide leeway in water-level and allowable boiler-water concentration is provided by the large drum and efficient cyclone steam separation system . . . which also contribute to ease in meeting sudden and severe load swings.

This unit incorporates all the advantages of Integral-Furnace design, which has proved so successful since its introduction by B&W in 1933. The popular Integral-Furnace "Family" now includes Types FH, FL, FJ, FF, and Shop-Assembled FM Units — spanning a range of steam-capacity now available from 2,800 to 350,000 lb. per hr.

Complete details of construction and operating advantages of the Integral-Furnace Boiler, Type FJ are included in new Bulletin G-70, available upon request from the Babcock & Wilcox Company, 85 Liberty Street, New York 6, N. Y.

BABCOCK & WILCOX

G-542

62 Years of Pioneering

overlooks nothing that science or skill can contribute to make fine bearings better. New Departure ball bearings are now performing a great variety of services vital to the future of our country.

Nothing Rolls Like a Ball...

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BALL BEARINGS

NEW DEPARTURE • DIVISION OF GENERAL MOTORS • BRISTOL, CONNECTICUT

MECHANICAL ENGINEERING, June, 1951, Vol. 73, No. 6. Published monthly by The American Society of Mechanical Engineers, at 20th and Northampton Sts., Easton, Pa. Editorial and Advertising departments, 29 West 39th St., New York 18, N. Y. Price to members and affiliates one year $3.50, single copy 50¢; to nonmembers one year $7.00, single copy 75¢. Postage to Canada, 75¢ additional, to foreign countries $1.50 additional. Entered as second-class matter December 21, 1920, at the Post Office at Easton, Pa., under the Act of March 3, 1879. Member of the Audit Bureau of Circulations.

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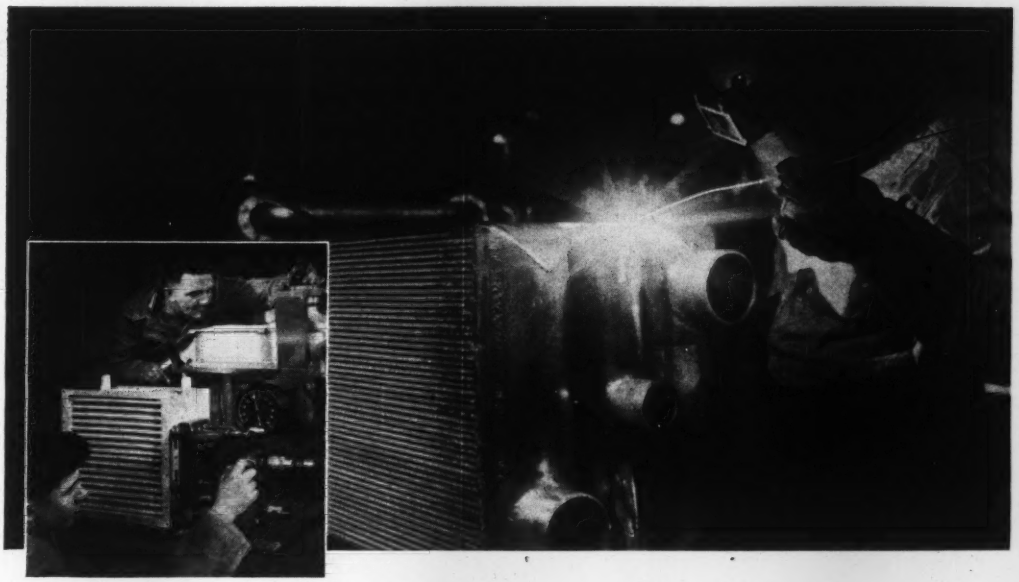
OilFoil
LUBRICATION
SEALING
American Felt Company



TRANE Announces a New Kind of

LIGHTWEIGHT HEAT TRANSFER SURFACE

Here are the simple facts about Trane *Brazed* Aluminum Surface – a new type of heat exchanger now available for the chemical and process industries:

1. Much lighter than conventional fin-and-tube heat transfer equipment.

2. So strong it has been successfully tested at pressures up to 1000 pounds per square inch. Has withstood 2 million reversals at 100 pounds pressure.

3. Packs up to 450 square feet of total surface in a cubic foot of volume – up to nine times the surface of a comparable volume of ¾" tube shell-and-tube heat exchanger.

4. Operates successfully in temperature ranges from 500°F. to –300°F.

5. One-third to one-half the price of the lowest cost tubular exchanger.

This new heat transfer surface is fabricated entirely of aluminum. Layers of corrugated aluminum sheet – separated by thin plates – are brazed in an exclusive flux bath process. Joints are as strong as the aluminum itself. Brazing is even -- bonding uniform. The heat exchanger can be built either for counterflow or crossflow circulation. Headering can be designed to fit the job.

Trane *Brazed* Aluminum Surface can be used for gas to gas, gas to liquid, or liquid to liquid heat transfer. Complete flexibility creates almost unlimited possibilities for its use.

Trane *Brazed* Aluminum Surface will meet practically any specification of heat transfer, pressure drop, volume, number and direction of passes and velocity of fluids.

Trane *Brazed* Aluminum Surface has been completely tested in numerous applications. During the last war, hundreds of aircraft engines were cooled with Trane Aluminum Radiators – one of the earlier forms of the new brazed aluminum surface.

Certain limitations exist on this surface. It is available only in aluminum at present. Small quantities are not economical.

This new development is but a part of the extensive Trane line of heat transfer equipment. Also included is shell-and-fin-tube and fin-tube surface in a wide variety of combinations, tube sizes and materials. If you have a knotty heat transfer problem you may find the answer in the Trane line. Contact the Trane Sales Office nearest you or write direct.

THE TRANE COMPANY, LA CROSSE, WISCONSIN • **Eastern Mfg. Division, Scranton, Penna.**
Trane Company of Canada, Ltd., Toronto • **Offices in 80 U. S. and 14 Canadian Cities**

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MANUFACTURING ENGINEERS OF HEATING, VENTILATING AND AIR CONDITIONING EQUIPMENT

you Specify *

if it's a wire spring .
spring washer . . . . . .
flat spring . . . . . .
or wire form . . . . .

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Bristol Connecticut

G.S. Gearing Assures Smoo[illegible] Efficient Operation For SKILSAW

SKILSAW Portable Tools have built an enviable reputation for smooth, efficient operation. Their ability to give such remarkable service and satisfaction is the result of the high precision standards established for every component part by a quality-wise manufacturer!

Foremost among the critical parts responsible for the purring performance of these excellent tools is the Fractional Horsepower Gearing by G.S.! Made in production-run quantities, to the most exacting specifications, these *better* spiral bevel Gears and Pinions have contributed substantially to the excellence of SKILSAW!

If decidedly better, more uniform Gearing from 12 to 96 D.P. is a consideration in YOUR business, by all means, *entrust* the job to G.S. Get all the advantages that only large scale operations and *30 years of specialization* can give. Send us drawings, specifications, samples, and other details today!

Send for [illegible] Now

6-pa[illegible] illustrates and descri[illegible] Gearing and app[illegible] handy charts, for[illegible] ring from 12 to [illegible] you ask for it on c[illegible] ase?

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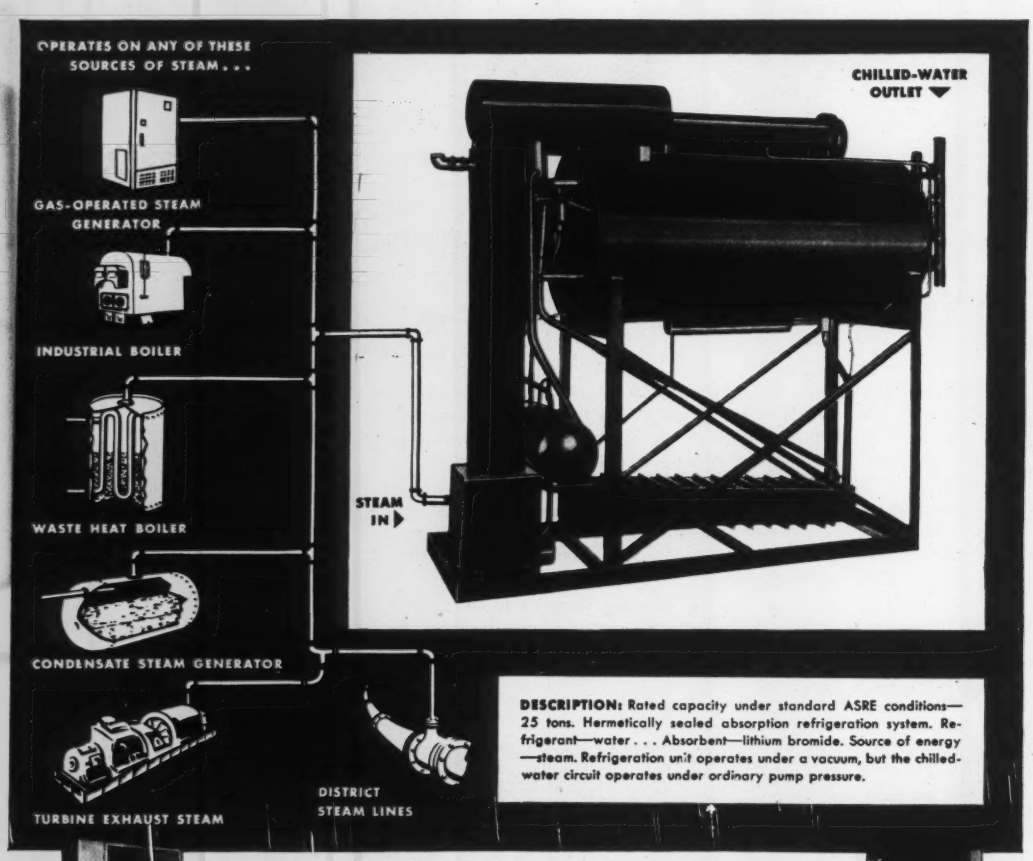
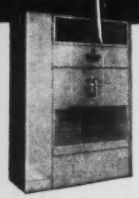
New Servel Water new horizons in

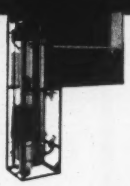

OPERATES ON ANY OF THESE SOURCES OF STEAM . . .
GAS-OPERATED STEAM GENERATOR
INDUSTRIAL BOILER
WASTE HEAT BOILER
CONDENSATE STEAM GENERATOR
TURBINE EXHAUST STEAM
DISTRICT STEAM LINES
CHILLED-WATER OUTLET
STEAM IN
DESCRIPTION: Rated capacity under standard ASRE conditions—25 tons. Hermetically sealed absorption refrigeration system. Refrigerant—water . . . Absorbent—lithium bromide. Source of energy—steam. Refrigeration unit operates under a vacuum, but the chilled-water circuit operates under ordinary pump pressure.



SERVEL STEAM-OPERATED AIR CONDITIONERS

Self-Contained Unit. 5 tons of refrigeration. Heating optional.

Absorption Refrigeration Unit. In 3- and 5-ton sizes. For single or multiple installations.



Chiller opens application flexibility

25-Ton Servel Absorption Unit Provides Long-Life Refrigeration from Inexpensive Steam

The application flexibility of this new Servel Water Chiller makes it an economical source of chilled water for most applications. These points show how easily it will fit your requirements:

NUMEROUS USES—Comfort air conditioning . . . industrial temperature and humidity control . . . precooling for air compressors and internal combustion engines . . . chilled water for manufacturing processes . . . and many others.

STEAM OPERATION—Use the cheapest source of steam . . . any pressure will do. Use the cheapest fuel to make steam—waste heat or manufacturing by-products if available . . . or waste steam.

SIMPLE INSTALLATION on any floor from basement to penthouse . . . in multiple or single installations . . . low floor loading . . . no vibration . . . quiet operation.

MODULATION—Use simple steam controls to reduce capacity of the Servel unit as much as 50% . . . with no appreciable loss of efficiency.

In addition to these important flexibility factors, the new Servel Water Chiller also offers the famous Servel no-moving-parts freezing system. This insures dependable operation, long life, and low maintenance. Add this advantage to its numerous uses, its steam operation, simple installation and capacity modulation, and you'll choose the new Servel Water Chiller* every time.

Mail coupon now, for complete information.

*NOTE: The nation's present need for critical materials limits the availability of the Servel Water Chiller to defense orders at present. However, the Servel equipment shown at the bottom of the opposite page is available without priorities.

HERE ARE SOME REASONS WHY SERVEL IS YOUR BEST AIR CONDITIONING BUY

- **No Moving Parts to Wear**
- **Low Maintenance Costs**
- **Hermetically Sealed Circuits**
- **Long Life**
- **Complete Safety of Operation**
- **Chilled Water Circuit Operates Under Normal Pump Pressure**

SEND COUPON FOR MORE INFORMATION

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EVANSVILLE 20, INDIANA

WATER HEATERS **AIR CONDITIONING**
HOUSEHOLD REFRIGERATORS

Servel, Inc.
Department U26, Evansville 20, Indiana

Gentlemen:

Please send me more information on the following:

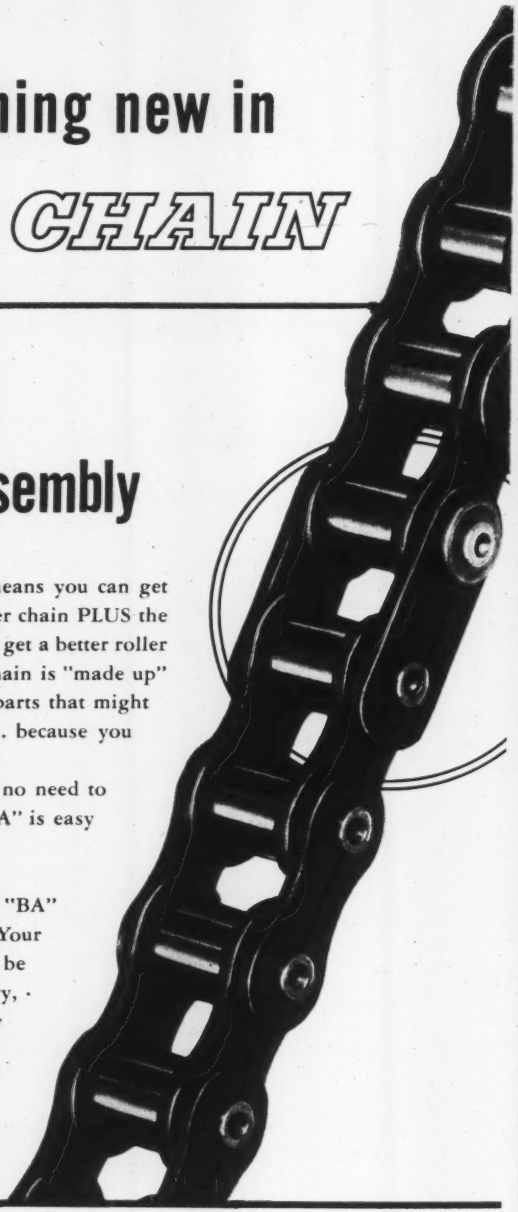
Servel 25-Ton Water Chiller_____
Servel Self-Contained Air Conditioner_____
Servel 3- and 5-Ton Refrigeration Units_____

*Name*_____

*Firm*_____

*Address*_____

there IS something new in ROLLER CHAIN



the revolutionary Baldwin-Rex "BA" Assembly

TO YOU... This great new development means you can get the strength, long life and lower cost of riveted roller chain PLUS the easy assembly and disassembly of cottered chain. You get a better roller chain, *first* because it's riveted—*second* because the chain is "made up" to size, not "cut up" with possible damage to chain parts that might weaken it. You'll save because it's lower in cost . . . because you waste no chain through damage in cutting.

You can reduce your inventory materially. There's no need to order long lengths and cut them as needed. And "BA" is easy to order . . . easy to stock.

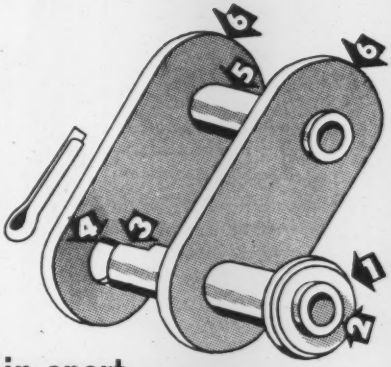
TO YOUR CUSTOMERS... With "BA" on your machines, you're offering a better product. Your customers like the ease with which "BA" Chains can be coupled and uncoupled. If a replacement is necessary, it's easy with "BA". They'll like the longer life they get with Baldwin-Rex "BA" Riveted Chain. They can even replace a small worn section of drive quickly and easily.

BALDWIN·REX

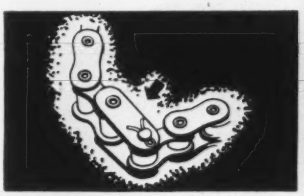
Baldwin-Duckworth Division of
CHAIN BELT COMPANY
Springfield 2, Mass.

here's the "BA" secret!

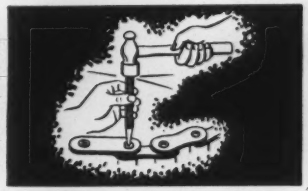
The secret of the Baldwin-Rex "BA" Assembly is the *Single Pin* Connector. A washer (1) is spun over the head of the connector pin (2). The milled flat (3) at the cottered end of the pin fits into a special hole in the side plate (4). This combination holds the pin firmly in place, yet it's easy to remove because it's a "sliding fit" through the entire link except for the milled flat end. The riveted pin at the other end of the link (5) holds the side plates (6) firmly in place when single pin connector pin is removed.



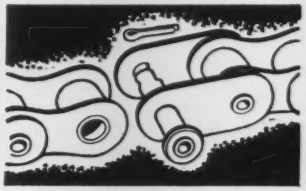
look how easy it is to take this chain apart



Locate the single pin connector link in the strand. It's easily identified by its distinctive shape.



Next, remove the cotter and drive the milled flat end of the pin out of the special hole in the side plate. It will slide out easily. No danger of destroying chain parts or damaging fits.



There it is—that's all there is to it. The chain is apart in a matter of seconds. It's as simple as that. And assembly is just as easy.

any length of chain you want . . . *when you want it!*

Baldwin-Rex "BA" Assembly Chain is shipped in standard 5-foot lengths—two lengths to a box. From these 2 units plus the standard "BA" short units, you can build up any length you want from one link to 10 feet. Or, if you prefer, you can order pre-assembled lengths in quantity. In either case, you're getting "made up" chain—not "cut up" chain.

For the complete story on "BA", simply mail the coupon.

CHAIN BELT DISTRICT SALES OFFICES

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51-407

Baldwin-Duckworth Division of Chain Belt Co.
363 Plainfield Street
Springfield 2, Mass.

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Please send me bulletin 50-6.

Name.....

Company.....*Dept*.....

Address.....

City.....*State*.....

Tubing troubles got your goat?

Bundyweld Tubing, double-walled from a single strip. Exclusive, patented beveled edge affords smoother joint, absence of bead, less chance for any leakage.

If you're butting up against costly rejects, time-taking inspections, poor performance in your tubing unit, you ought to get the facts on Bundyweld.

This multiple-wall type of Bundy® tubing is double-rolled from a single strip, unmatched by any other tubing.

It's amazingly rugged, easy to form and fabricate. It conducts heat faster, and withstands gruelling vibration in lines and coils that have to take a shaking.

Right now, defense and essential production rate top call on Bundyweld, though we're doing everything possible to service all Bundy customers. Why not inquire regarding your needs?

Bundy Tubing Company

DETROIT 14, MICHIGAN

World's largest producer of small-diameter tubing

AFFILIATED PLANTS IN ENGLAND, FRANCE AND GERMANY

What's the cheapest refrigerant?

Water.

And it's good, too. Especially the way we use it in the new Carrier Absorption Refrigerating Machine.

We take our refrigerant in from the load and spray it into the cooler. Because our absorbent keeps the pressure low, some of the water flashes and cools the remaining water. Then the water is pumped off to the load.

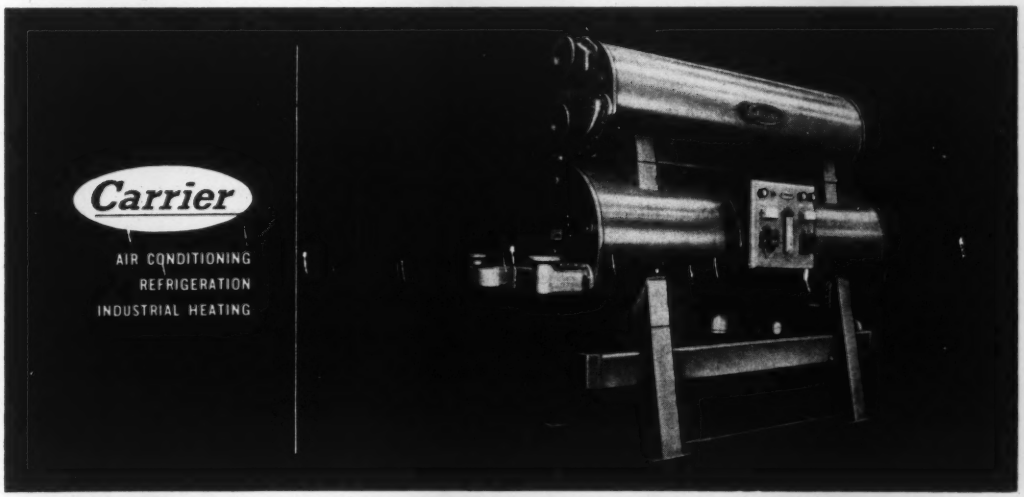
As the absorbent picks up the water vapor and becomes diluted it is pumped to the generator where steam boils off the water vapor. This vapor is then condensed and returned to the chilled water circuit.

Do you get the picture? This is a simple machine. It has no moving parts . . . except for one small pump.

So with no moving parts you'll have little maintenance . . . and there won't be any vibration . . . so you won't need heavy (and expensive) foundations.

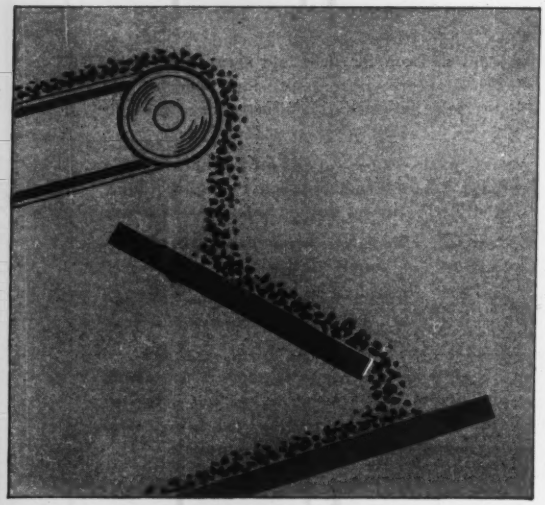
And it's powered by high or low pressure steam . . . which isn't expensive . . . especially in the summer. You get a ton of refrigeration, by the way, for 20 pounds of steam per hour. And the machine adjusts itself to loads down to 10% of capacity.

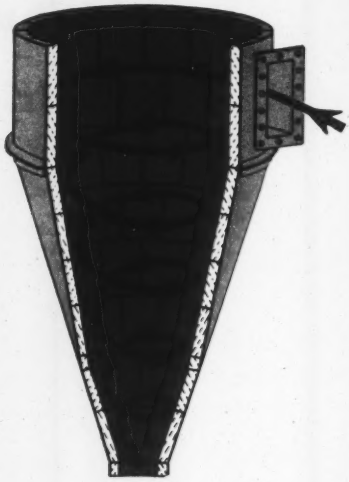
Beyond this, with a salt absorbent (which won't poison anybody, won't burn or explode) and water as a refrigerant, the machine is absolutely safe. A booklet tells the whole story. It's yours for the asking. Carrier Corporation, Syracuse 1, N. Y.



The Carrier Absorption Refrigerating Machine is available in 115, 150, 200, 270 and 350 ton capacities. It is readily adaptable to multi-unit installations.

abrasion?





erosion?

Here are even tougher

The weak link in keeping certain equipment on the production line often lies in rapid abrasion and erosion of vulnerable areas. For example:

In Cyclone Dust Collectors where there's a ceaseless blast of highly abrasive particles.

In Coke Chutes and Hoppers which must withstand constant cascades of fiery coke or cold coke.

In Hot Blast Mains through which dust-laden gases travel at high velocities.

In Billet Heating Furnaces through which hundreds of massive metal slabs are pushed.

Under conditions like these, metals, paving bricks and other normally durable materials are simply worn away — and in very short order. It takes exceptionally tough linings or bearing surfaces — as provided by our MONOFRAX K fused cast blocks or our CARBOFRAX silicon carbide bricks and shapes — to stand the gaff.

Both these Super Refractory materials by CARBORUNDUM *are within one index point of diamond hardness!* It is this hardness that gives these Super Refractories their exceptional resistance to abrasion—from room temperature to high heats.

Granted, abrasion is seldom an isolated condition. It's usually abrasion *plus* . . . heat, or acid attack, or some other condition. But, as you can see (top, opposite page), these Super Refractories have many other properties, equally as desirable as abrasion resistance and equally important in certain applications.

Information is now available on all the various groups of Super Refractories by CARBORUNDUM. Just send the coupon and you'll receive our new booklet. No obligation, of course.

THE CARBORUNDUM COMPANY

Refractories Division • **Perth Amboy, New Jersey**

"Carborundum," "Carbofrax," "Monofrax" and "Alfrax" are registered trademarks which indicate manufacture by The Carborundum Company.

SUPER REFRACTORIES ARE ALSO USED

WHERE HEAT CONDUCTIVITY IS NEEDED. At elevated temperatures CARBOFRAX refractories conduct heat as rapidly as chrome-nickel steels! This characteristic is invaluable in checkers, muffles, hearths, etc.

WHERE CHEMICAL ACTION IS PRESENT. In general, all Super Refractories are either neutral or acid in nature — are widely used where chemical inertness is important.

WHERE STRENGTH IS IMPORTANT. No commercial tonnage refractories have greater strength than Super Refractories. All can withstand over 300 psi at 2750° F without crushing.

WHERE HIGH HEAT IS INVOLVED. They can be safely used at temperatures over 3000° F. They are very durable — are highly resistant to spalling and cracking. Some varieties are almost indispensable where flame impingement or violent temperature changes are present.

WHERE INSULATION IS NEEDED. One of these products, ALFRAX BI aluminum oxide material, consists structurally of many hollow spheres. It's one of the best insulating materials at very high temperatures.

WHERE SPECIAL SHAPES ARE INDICATED. Practically all Super Refractories are available either as bricks or special shapes molded to close tolerances — including fitted joints, tubes, etc.

Do any of these suggest possible applications?

materials of construction than grinding wheels

The important thing about Super Refractories by CARBORUNDUM is NOT just that they are "better" than standard fireclay refractories. The important thing is that they are actually *a class apart* — with many entirely different properties and applications. (For example, some of their properties — such as abrasion resistance — are important *regardless of whether high temperatures are involved.*)

Nor is their principal value simply that they cure trouble-spots where other materials (e.g., refractories, metals, etc.) fail to stand up. Their value usually lies in increasing capacity and reducing overall operating costs. (For example, regenerator checkers made of CARBOFRAX brick absorb and release over 3 times as much heat as checkers made of ordinary refractories when cycles are short.)

WHY NOT CHECK UP? We have a new booklet which outlines the unusual characterictics of these special purpose materials. The coupon will bring you the story — or one of our engineers would be happy to talk over your specific problems. We believe it could be mutually profitable.

This advertisement — one of a series — is presented in the belief that in the unusual properties of the various Super Refractories by CARBORUNDUM lies the key to many new or improved processes. We would like to talk over specific jobs with anyone who sees such possibilities.

Dept. P-61
Refractories Div., The Carborundum Co.
Perth Amboy, New Jersey

Please send your free booklet on properties of Super Refractories

Name_____

Position_____

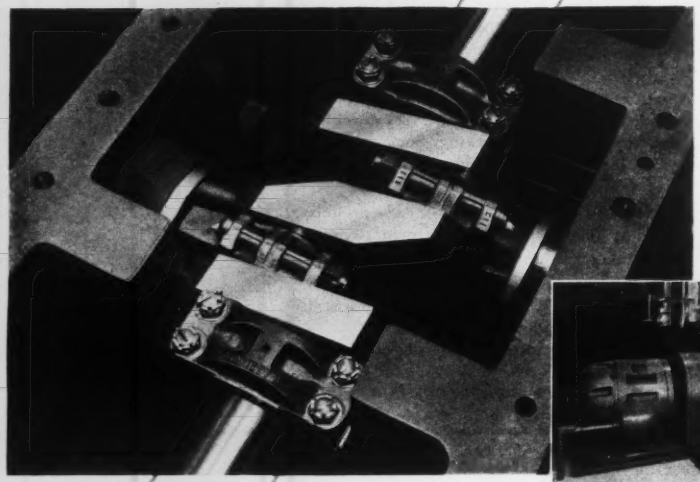
Company_____

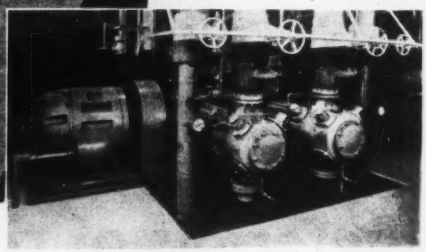
Street_____

City_____ **Zone**_____ **State**_____

the mighty heart...

THAT IMPARTS UNRIVALED DURABILITY





Clark CMA-4, 300 bhp, 600rpm, balanced/opposed, motor driven compressor in chemical company dry ice plant.

Rugged, smooth-functioning and vibration-free, this is the mighty heart that imparts unrivaled durability to Clark Balanced/Opposed, Motor-Driven Compressors.

With a sturdy, generously proportioned, one-piece forged steel crankshaft, to assure a full lifetime of continuous service . . . with cylinders mounted on opposite sides of the crankcase and driven from adjacent 180° opposed crankthrows, to cancel out all unbalanced forces (without use of counter weights) . . . it's easily understood why the Clark CMA balanced/opposed design "belongs" wherever air or gas must be compressed. For, its smooth, vibration-free performance holds down foundation size, installation and maintenance costs, while its compactness reduces floorspace requirements.

Clark balanced/opposed compressors are available in a range of sizes from 150-4500 bhp. Full data and literature are available from your nearest Clark representative.

MIDGET ANGLE • RIGHT ANGLE • BIG ANGLE
ELECTRIC-DRIVEN • CENTRIFUGAL

SEE the difference in

CLARK

CLARK BROS. CO. INC.

One Of The Dresser Industries

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New York • Tulsa • Houston • Chicago • Boston
Washington • Los Angeles • Birmingham • Detroit
Salt Lake City • San Francisco • London • Paris
Varese, Italy • Buenos Aires • Caracas, Venezuela
Lima, Peru • Bogota, Colombia • New Delhi, India

Balanced/Opposed COMPRESSORS

C-E REHEAT BOILERS

CLERMONT STATION

THE CINCINNATI GAS & ELECTRIC COMPANY

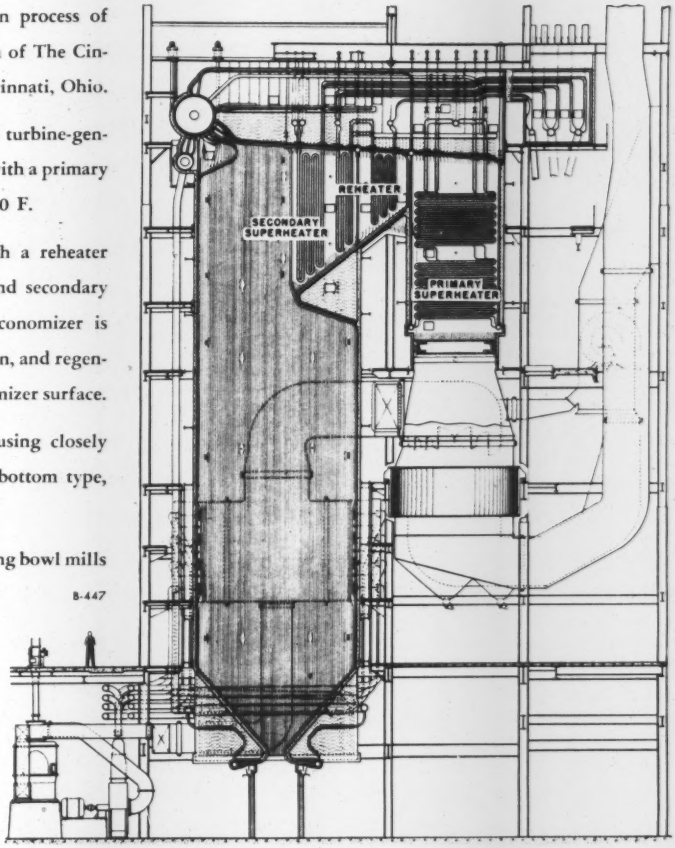
THE C-E Unit shown here is now in process of fabrication for the Clermont Station of The Cincinnati Gas & Electric Company at Cincinnati, Ohio.

It is designed to serve a 100,000 kw turbine-generator at a throttle pressure of 1450 psi with a primary temperature of 1000 F reheated to 1000 F.

The unit is of the radiant type with a reheater section located between the primary and secondary superheater surfaces. A finned tube economizer is located below the rear superheater section, and regenerative type air heaters follow the economizer surface.

The furnace is fully water cooled, using closely spaced plain tubes. It is of the basket-bottom type, discharging to a sluicing ash hopper.

Pulverized coal firing is employed, using bowl mills and tilting, tangential burners. B-447

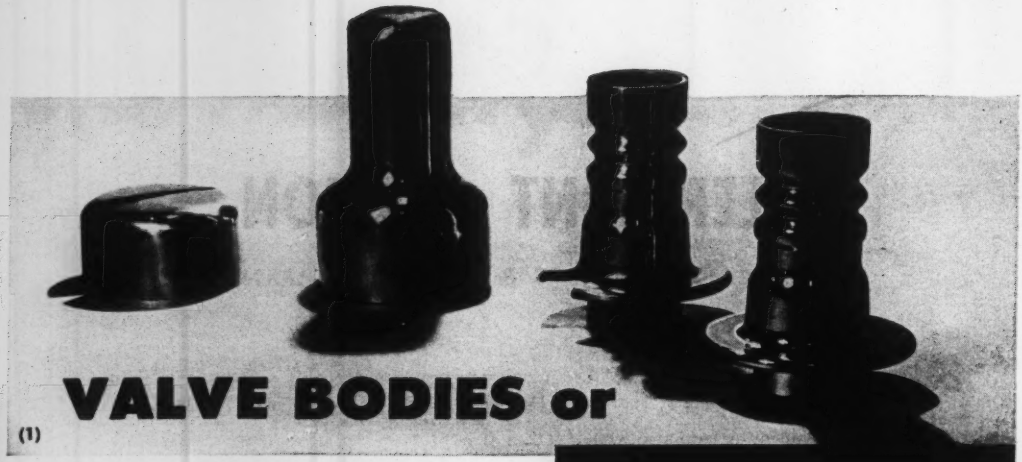


C-E

COMBUSTION ENGINEERING—SUPERHEATER, INC.

200 Madison Avenue • New York 16, N. Y.

ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS; ALSO SUPERHEATERS, ECONOMIZERS AND AIR HEATERS



VALVE BODIES or PENKNIVES

(1)

(2)

How Two Manufacturers Improved Their Products . . . Pared Their Production Costs

(1) This illustration shows only four steps in the manufacture of a valve body from Revere 70-30 Cartridge Brass by Eastern Tool & Stamping Co., Saugus, Mass. Eastern was asked to quote on making this body as a stamping, to replace a casting. Due to the design of the part, it was felt that it would be especially difficult to produce from brass strip. Hence Revere was asked to collaborate on specification and fabrication. A close study of the fabrication steps resulted in the recommendation of 70-30 brass in a certain grain size. The latter is kept under control by Eastern through only two intermediate anneals. The result is a most unusual drawn and formed part, lighter, better, and more economical than the former casting. (Revere has no objection to castings as such. The important thing is to use them only if they are more economical and satisfactory.)

(2) Penknives, fisherman's knives and similar items made by the Utica Cutlery Company, Utica, N. Y., contain liners of brass which provide the proper clearances between the blades. These not only have to be blanked to the proper shape, but also must be punched with small holes for the rivets. Some of the holes must be "punched clean" with a minimum amount of burr. Others are produced with a blunt punch so that the metal is extruded slightly around each hole. The Revere Technical Advisory Service was consulted, with the result that Revere now supplies brass in a temper which blanks cleanly, but which also produces the exact amount of extruded metal around the desired holes in the customer's operation. In this case, it was proper temper which eliminated rejections and added to the quality of these already fine knives.

• These two cases are typical of the results obtainable when Revere and a customer sit down together to share their knowledge with each other. In these times, when more and more companies are planning to switch to Defense Orders, such collaboration can be exceptionally valuable. May we work with you?

REVERE 150 YEARS SERVING AMERICA

COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

230 Park Avenue, New York 17, N. Y.

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Mills: Baltimore, Md.; Chicago and Clinton, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Rome, N. Y.— Sales Offices in Principal Cities, Distributors Everywhere.

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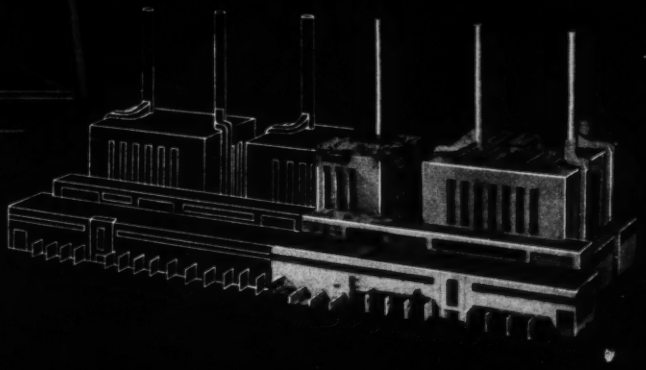
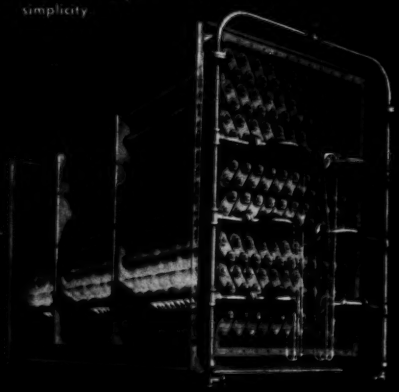
the **FUTURE**... an extension of the present



STEAM GENERATORS for every industry designed, engineered and built to meet existing and anticipated needs of a growing economy.

AUXILIARY STEAM GENERATING EQUIPMENT . . .

The Foster Wheeler cast-iron, extended surface steel tube Economizer can be depended on for superior service because it is (1) corrosion resistant, (2) impervious to soot fires, (3) cleanable and (4) unique in its simplicity.



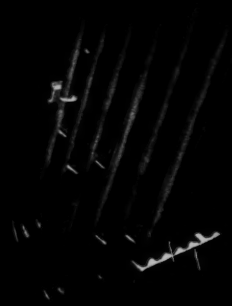
RADIANT REHEATERS

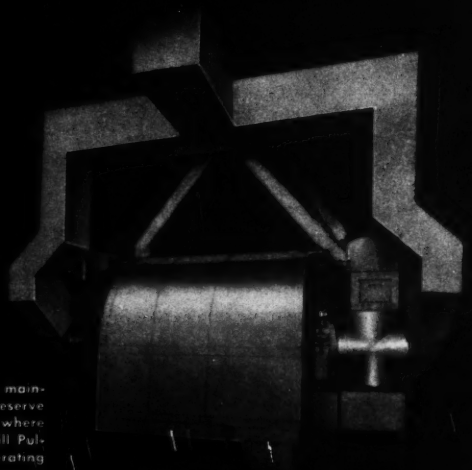
RADIANT SUPERHEATERS

Over the past several years increased emphasis has been placed on Reheat as a means toward better station heat rate. Foster Wheeler experience in the design and fabrication of Reheaters may be measured partly by the consistently successful operation of one of the world's most efficient power stations where Foster Wheeler Radiant Reheaters and Radiant Superheaters are installed.

TU[illegible]ULAR AIR HEATERS, WATER WALLS, MULTI-FUEL BURNERS, WASTE HEAT BOILERS

oster Wheeler, first to develop the use of superheated team in this country, designs, engineers, and fabriates convection and radiant type superheaters singly r in combination. SUPERHEAT CONTROL over a wide oad range is also offered as a means of positive and ccurate control of final temperature.

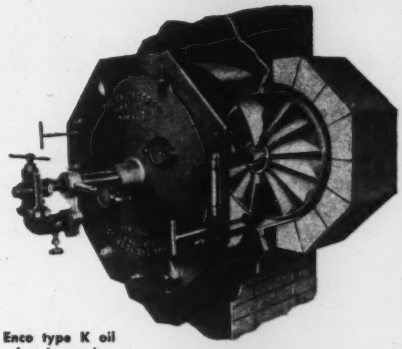




High availability, low maintenance, and large reserve capacity are assured where Foster Wheeler Ball Mill Pulverizers are used. Operating records consistently show a remarkable availability of 99% or better.

FOSTER WHEELER CORPORATION · 165 BROADWAY, NEW YORK 6, N. Y.

ENCO
OIL and GAS
BURNER UNITS



Enco type K oil burning unit

High load or low, you can count on completely uniform combustion and greater fuel economy with the Enco Type K Oil and Gas Burner Unit. It is flexible three ways . . . (1) designed for use with either oil or gas—or both, (2) flexible where steam demands swing sharply and (3) can be operated by either natural or forced draft.

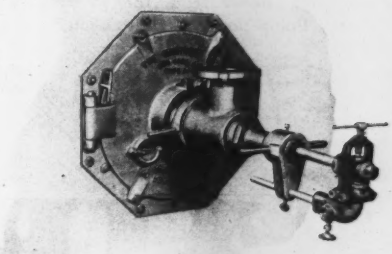
ENCO BURNER UNITS ARE MADE in many sizes to suit all capacity requirements.

Enco Interchangeable Atomizers

Wide Range Mechanical—Capacity range of 10 to 1. Manual or automatic control. Constant high oil pressure at atomizer insures efficient atomization over entire load range without recirculating or returning oil.

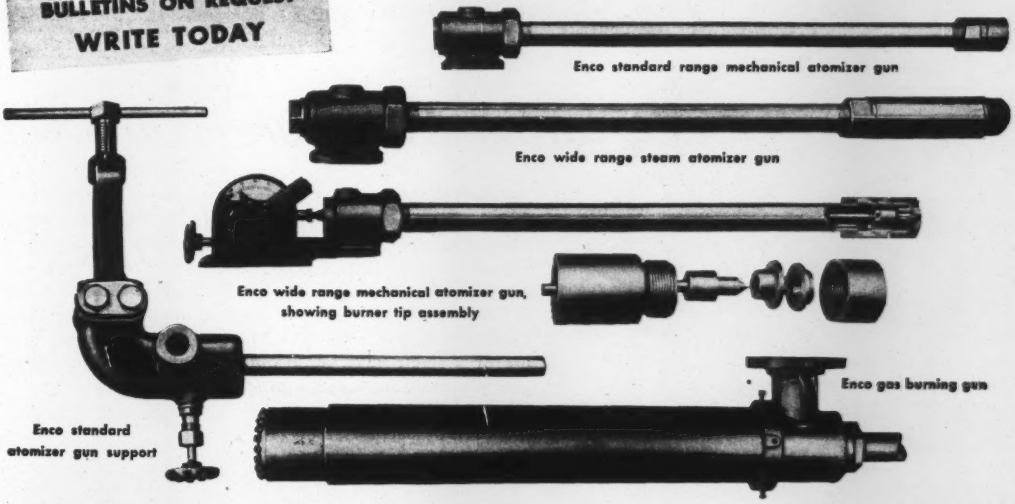
Steam or Air—Capacity range of 10 to 1. Controlled by manual or automatic pressure regulation.

Standard Range Mechanical—Available in all sizes to suit load and capacity requirements.



Enco type K gas-oil burning unit

BULLETINS ON REQUEST
WRITE TODAY



Enco standard range mechanical atomizer gun

Enco wide range steam atomizer gun

Enco wide range mechanical atomizer gun, showing burner tip assembly

Enco gas burning gun

Enco standard atomizer gun support

EC-682

THE ENGINEER COMPANY 75 WEST STREET, NEW YORK 6, NEW YORK

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when the ACCENT is on the Positive

. . . then the positive pumping of Fairbanks-Morse Rotary Pumps offers the best choice for your equipment. They efficiently handle any free-flowing liquid from gasoline to molasses with exceptionally high efficiency. Non-fluctuating load characteristics minimize shock and vibration . . . assure long, economical service.

Only TWO parts move in Fairbanks-Morse Rotary Pumps . . . a precision-cut rotor and pinion gear. There are no complicated parts to cause trouble or to require frequent maintenance and adjustment. Capacities range from ⅜ to 5 inches. If your design problems involve positive pumping, choose from the Fairbanks-Morse Rotary Pump line . . . the economical choice.

FAIRBANKS
A NAME WORTH

..when HEADS are up or down

A Fairbanks-Morse Westco turbine-type pump is the efficient answer. The unique design employed in these exceptionally compact pumps permits them to handle widely varying heads with little or no loss of capacity. Maximum capacity is obtained at an operating speed of 1750 r.p.m. when discharging at low pressure, and high pressures are developed at the same speed with little change in capacity. In addition, through the use of a single-stage, multi-vaned impeller, Westco Pumps give you multi-stage performance from a single-stage pump. Westco Pumps are widely used as integral parts of machines, units or systems. Capacities from 1 to 200 g.p.m. Check them for your equipment.

Other FAIRBANKS-MORSE Pumps Include

Builtogether Centrifugals

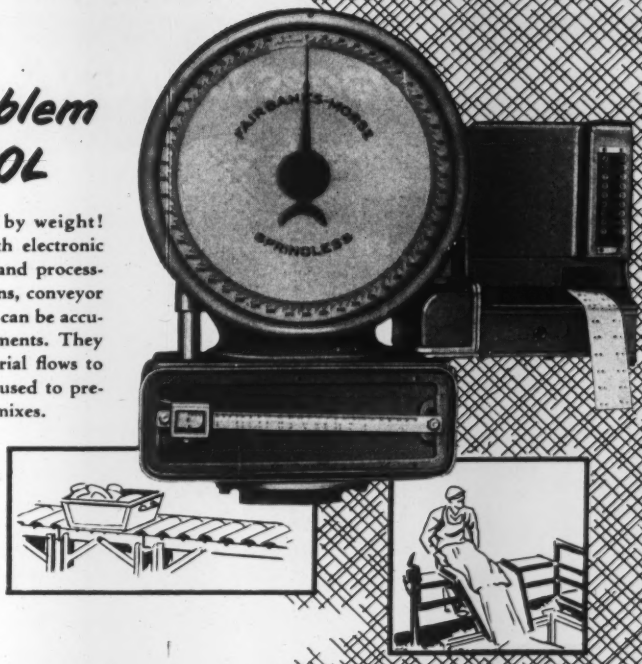
Side-Suction Centrifugals

Single and Two-Stage Centrifugals

when it's a problem of CONTROL

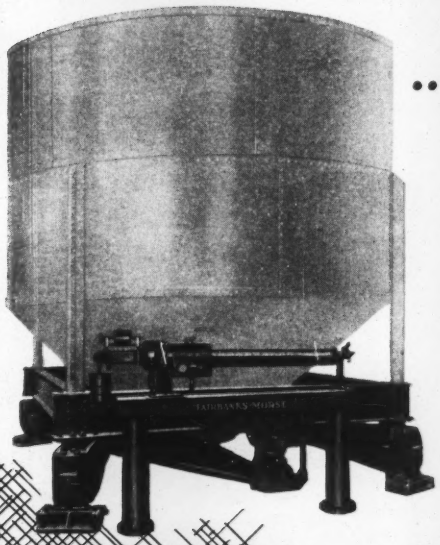
. . . consider the advantages of control by weight! Fairbanks-Morse Printomatic Weighers with electronic attachments accurately control production and processing operations. Materials handling operations, conveyor systems, processing and batching operations can be accurately controlled by these precision instruments. They can open and close valves controlling material flows to predetermined quantities. Templets can be used to preserve formula secrets when compounding mixes.

In addition, accurate records of materials can be kept since the Printomatic will furnish printed records of operations. The human element and chance for error are eliminated. Check your Fairbanks-Morse weighing expert on the advantages Printomatic offers you.



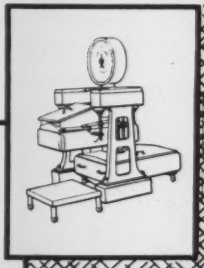
-MORSE
REMEMBERING

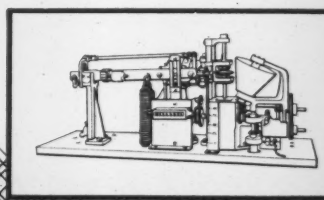
See Next Page for
FAIRBANKS-MORSE
Sales Centers



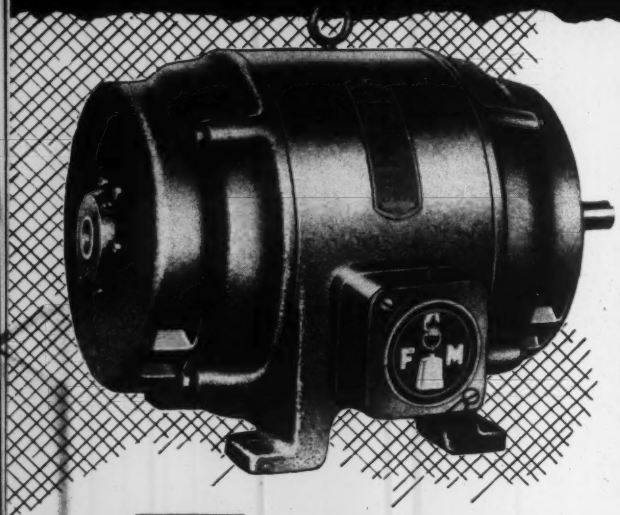
...when it's a problem in weight

. . . the easy answer is in the complete Fairbanks-Morse scale line. Beam scales or dials, belt conveyor scales, aggregate weighing scales, proportioning and batching scales, truck scales, furnace charging scales, you'll find them all and more. An important point—Fairbanks-Morse Scales *or component scale parts* can be supplied to fit right into your equipment for weight or control operations. Your Fairbanks-Morse weighing expert will be happy to work with you on any scale problem.





MOST Advantages for MOST Motor Applications



STANDARD DRIP-PROOF MOTORS FOR YOUR PROTECTION

Practically every motor needs protection—from flying chips, falling particles, dripping liquids, and the like. Also, by far the majority of motors used are of the polyphase, squirrel cage type.

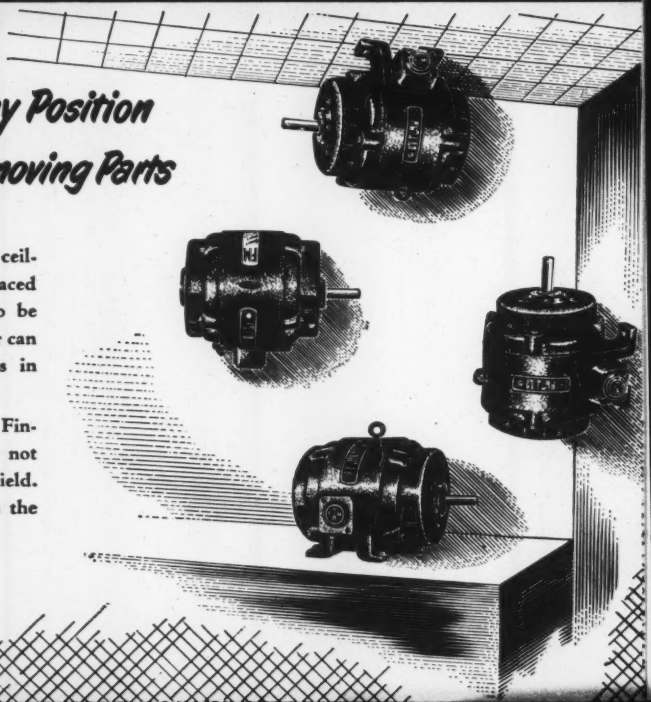
These requirements are met to a unique degree by this series of Fairbanks-Morse motors—with built-in protection and superior electrical and mechanical design that account for their popularity throughout industry.

Whether your motor application problems involve driving pumps, machine tools, compressors, elevators, fans—or any of an infinite number of other applications—Fairbanks-Morse Standard Drip-proof Motors deserve your early investigation. Call your nearest Fairbanks-Morse Sales and Service center.

FAIRBANKS

A NAME WORTH

PROTECTION.. *in any Position*
SAFETY.. *no Exposed moving Parts*



Mount these motors anywhere—even on the ceiling or walls. Bearing arms have four bolts spaced 90° apart, enabling the bearing brackets to be adjusted to assure maximum protection. Motor can be mounted vertically without any changes in bearing construction.

There is complete safety for the operator. Fingers can even be placed in vents, for it is not possible to contact fans due to the protective shield. Smooth, streamlined external contour makes the motor easy to keep clean, easier to maintain.

Cross Flow Ventilation... Copper Spun Rotor

...OTHER UNIQUE FEATURES

Cross Flow Ventilation is an exclusive Fairbanks-Morse design that eliminates hot spots, prolongs the life of the stator installation.

Copperspun Rotor: a truly one-piece indestructible copper winding that withstands higher temperatures, has high electrical and thermal conductivity, better dynamic balance.

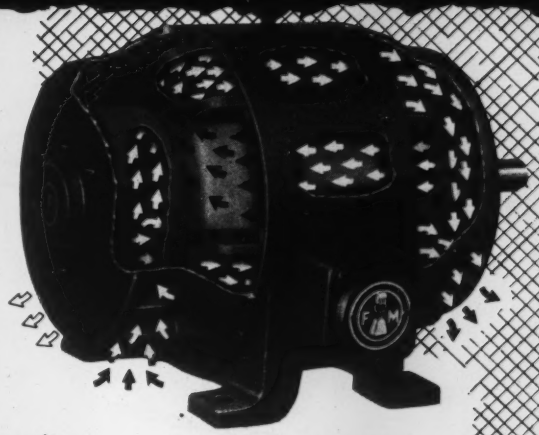
Rugged Frame Construction: Protection in any mounting position.

General purpose continuous duty: rated 40° C. and designed to carry 115% load continuously without injurious heating (1.15% service factor).

High efficiency, high power factor, good starting and accelerating torques.

Unique conduit box provides alternate assembly: either recessed, flush with frame or conventional external mounting.

Mounting dimensions conforming to NEMA standards.



Arrows show double flow of air that keeps motors running cool!

MORSE

REMEMBERING

These Are Your Fairbanks-Morse Sales Centers

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LIncoln 4210

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Room 605
6-2893

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CEntral 4347

DENVER 2, COLO.
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TAbor 6241

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GAspee 1-1531

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GArfield 4335

SALT LAKE CITY 1, UTAH
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HERE'S WHY

no other coupling costs as little to use as FAST'S

With Fast's Couplings you get the lowest coupling cost per year that modern engineering can provide—*because Fast's normally outlast the equipment they connect.* That means their cost can be spread out over 20 years or more!

As two users recently said:

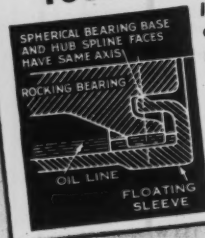
"We've had this Fast's Coupling since 1930 . . . and it's apparently going to last forever. [Wish] the other equipment caused as little trouble!" . . . "We have two Fast's Couplings . . . they are the only equipment so trouble-free we long ago forgot we had them!"

If you want lower costs, freedom from coupling shutdowns and dependable coupling engineering—specify Fast's. For complete details, mail the coupon for Fast's free catalog. Do it today!

RUGGED CONSTRUCTION:

Fast's still maintains its original design, without basic change or sacrifice in size or material. This assures you freedom from needless and expensive coupling failures.

FOOLPROOF DESIGN:



Instead of perishable oil seals, Fast's Couplings use a permanent metal-to-metal closure to keep dust out and oil in. Oil is always maintained at a safe level whether the Fast's is running or standing still.

FREE SERVICE:

When you specify Fast's Couplings you get Koppers' valuable free coupling service. If your application seems to need a special coupling, Koppers' engineers in many cases can easily modify a standard Fast's Coupling, and save you money!

MAIL COUPON TODAY FOR FREE CATALOG!

KOPPERS CO., INC., *Fast's Coupling Dept.*,
256 Scott St., Baltimore 3, Md.

Gentlemen: Send me Fast's Catalog which gives detailed descriptions, engineering drawings, capacity tables and photographs.

Name.....

Company.....

Address.....

City.....Zone.....State.....

KOPPERS

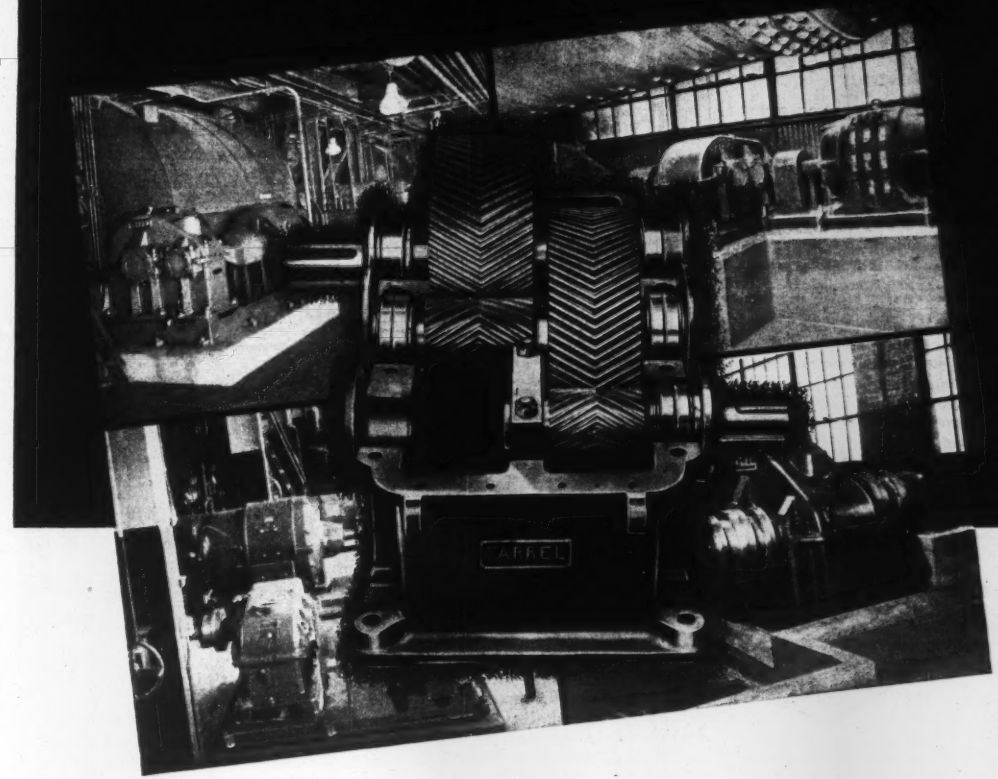
FAST'S

THE ORIGINAL GEAR-TYPE

Couplings

INDUSTRY'S STANDARD FOR 31 YEARS

has a special "aptitude" for its job



The design of Farrel speed reducers permits an engineering freedom in proportioning gears, shafts, bearings and even some housing dimensions to meet specific load, speed and service requirements. This flexibility has resulted in the solution of innumerable application problems.

In addition to this feature, Farrel speed reducers have a number of other advantages which help to account for their "aptitude" in handling tough assignments. The quiet, vibration-free performance of the herringbone gears results from extreme accuracy of tooth spacing, contour and helix angle . . . qualities inherent in the Farrel-Sykes method of gear generation. Precision manufacture and highest grade materials contribute to long gear life.

Shafts and bearings are factored to safeguard against interruption of vital processes. Gear cases are proportioned to withstand repeated heavy peak loads. Joints are sealed to prevent entrance of dirt.

Write for further details of these *problem-solving* units. Ask for a copy of Bulletin 449.

FARREL-BIRMINGHAM COMPANY, INC., ANSONIA, CONN.

Plants: Ansonia and Derby, Conn., Buffalo, N. Y.

Sales Offices: Ansonia, Buffalo, New York, Boston, Pittsburgh, Akron, Cleveland, Detroit, Chicago, Portland (Oregon), Los Angeles, Salt Lake City, Tulsa, Houston, New Orleans

Farrel-Birmingham®

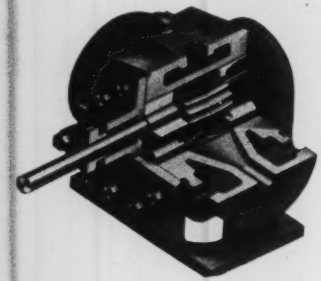
FB-644

SK News

Steam Jacketed Pump Handles Viscous Liquids At High Temperatures

The SK Steam Jacketed Herringbone Gear Pump shown in the break-away drawing is designed to handle viscous liquids such as resins, asphalts, and road oils at high temperatures efficiently and economically.

To insure even thermal distribution, the steam jacket on the pumps completely covers the internal parts. The inlet, outlet, and cover flanges are cast integrally with the pump base, and rigid housing construction eliminates any possibility of



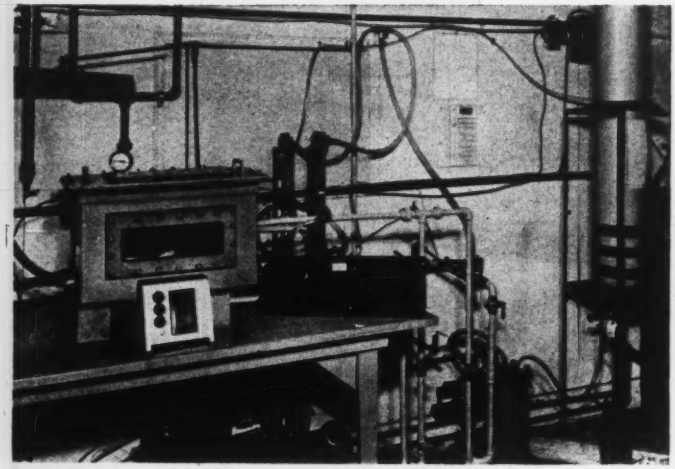
distortion due to pipe line strain or misalignment. Straight bore housing also prevents shaft deflection and bearing overhang.

Shafts are of heavy duty alloy steel, finish ground. Pressure on the stuffing box is dissipated through a channel in the cover plates. Steam connections on the jackets are designed to permit a variety of piping arrangements. Complete rotor and bearing assembly can be removed as a unit by releasing the coupling and removing the rear cover.

Pumps are available in Meehanite B, cast steel, bronze, or special alloy case. Internal parts are built to specifications.

For details on SK Steam Jacketed Pumps, request Bulletin 17-A, Supplement SJ.

SK Rotameters Control Flow In New Gas Plating Process



A new gas plating process under development at Commonwealth Engineering Company of Ohio utilizes the volatility and decomposition characteristics of certain metallic compounds such as carbonyls, nitrosyls, hydrides, salts, and metal organics to plate both metallic and non-metallic materials. Results of this process are similar in many respects to those obtained by electro-plating, however, gas plating permits the plating of non-conductors of electricity such as paper, plastics, tile and other non-metallic materials.

In this new process, SK Rotameters play an important role. In the pilot setup shown above, one SK Fig. 1891 Universal Rotameter is used to control the flow of carrier gas, usually carbon dioxide, while another is used to control the flow of nickel carbonyl-carrier gas mixture as it comes from a carburetor. Since the ratio between the nickel carbonyl and the carrier gas determines, to a considerable degree, the character of the films deposited, the importance of providing such accurate flow measurement can be realized.

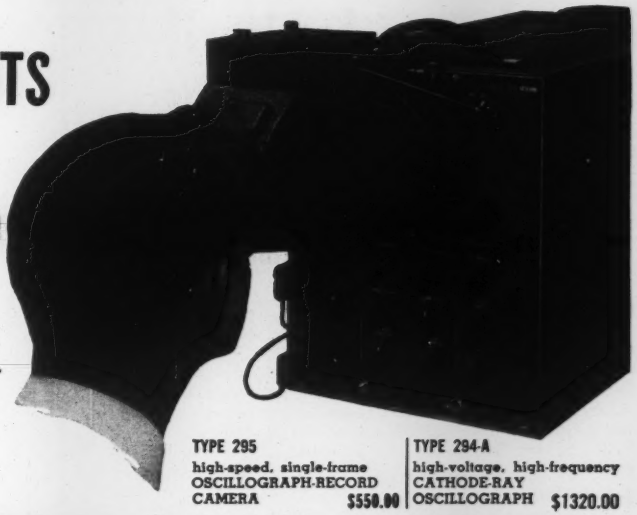
SK Universal Rotameters are available from stock. For detailed information, write for Bulletin 18-RB.

Manufacturing Engineers

A COMPLETE APPROACH TO

SINGLE TRANSIENTS and PULSES of low-repetition rate

For visual observation of pulses and single transients, the Type 294-A Cathode-ray Oscillograph provides high light-output and wide-band response. For careful study and permanent reference of these signals the Type 295 Oscillograph-record Camera records writing rates as high as 35 inches per microsecond.

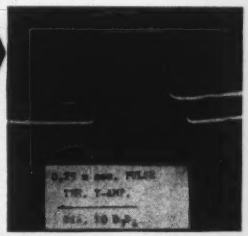


TYPE 295 high-speed, single-frame OSCILLOGRAPH-RECORD CAMERA $550.00

TYPE 294-A high-voltage, high-frequency CATHODE-RAY OSCILLOGRAPH $1320.00

PULSE RESPONSE FREQUENCY RESPONSE SENSITIVITY

This oscillogram illustrates the double exposure technique. Binocular viewing in the Type 295 facilitates proper positioning for close comparison.



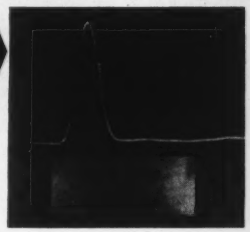
The pulses in the oscillogram at left are identical pulses of 0.25 microsecond width. The first pulse was applied through the Y-axis amplifier of the Type 294-A, and the second, directly to the vertical deflection plates. A comparison of their waveforms illustrates the excellent transient response of the Y-axis of the Type 294-A.

Response of the Y-axis amplifier to a rise time of 0.01 microsecond or less is 0.03 microseconds max. Notice that a minimum of overshoot (less than 2%) is introduced by the amplifier.

For the study of sinusoidal frequencies, the response of the Type 294-A extends from 10 cps. to 12 megacycles (down 30%). Sensitivity of the Y-axis, through the amplifier, is 0.42 peak-to-peak volts per inch.

AVAILABLE DEFLECTION LIGHT OUTPUT SIGNAL DELAY

"Time" and "Bulb" exposures may be taken with the Type 295. And provision is made so that equipment may be triggered simultaneously with shutter opening. With appropriate accelerating potentials, the Type 295 is capable of recording single transients in excess of 280 inches per microsecond.

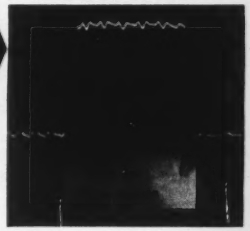


The Type 294-A provides undistorted vertical deflection of 1.3 inches or more for both positive and negative pulses; and 2.75 inches for symmetrical signals. The high light-output of the Type 294-A increases the value of the large, vertical deflection provided by the Y-axis amplifier. This is illustrated by the high visibility of the rise and decay of the pulse shown at left. Here, the Type 5XP— Cathode-ray Tube of the Type 294-A was operated at 12 kv. However, where maximum light output is not required, the accelerating potential may be lowered to 7 kv by means of a switch. At this level of operation, of course, the available undistorted deflection is increased.

To insure the complete display of fast pulses such as those at left, the Y-axis includes a 0.25 microsecond signal-delay line.

SWEEP SPEEDS TIME CALIBRATION

The built-in illuminated datacard of the Type 295 will prove invaluable when making time measurements. A film take-up cassette is arranged so that exposed frames of film may be separated from unexposed film and taken to the darkroom for immediate developing.



Complementing the Y-axis performance of the Type 294-A, sweep durations are continuously variable from 0.1 second to 3 microseconds. By increasing the length of the sweep, speeds greater than 0.25 microsecond per inch may be obtained, thus providing more detail to facilitate the study of short-duration pulses.

Calibration of the sweeps of the Type 294-A is accomplished with vertical marks occurring at intervals of 100, 10, 1, or 0.1 microseconds. In the oscillogram at left, the 0.1 microsecond markers appear mixed with the signal on the vertical axis. Time measurements may also be made by double exposure of first, the signal, and second, the timing markers.

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3. **Bearing expense saving**—No more burned out or damaged bearings with Farval protection. Expense of replacement eliminated.

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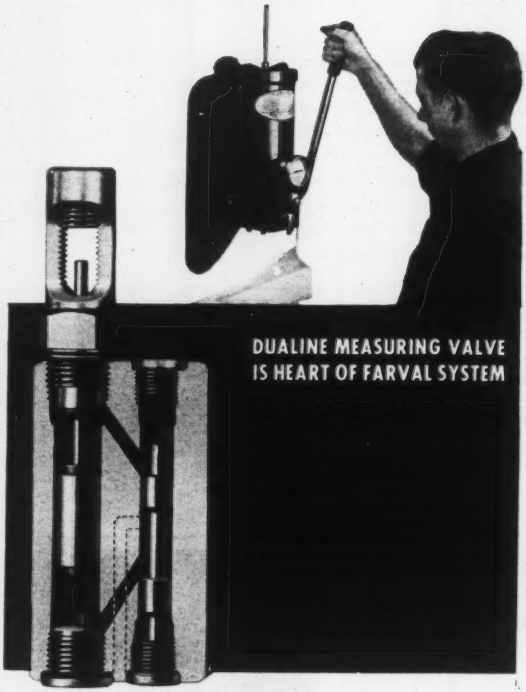

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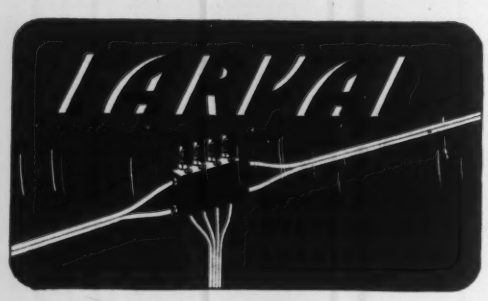

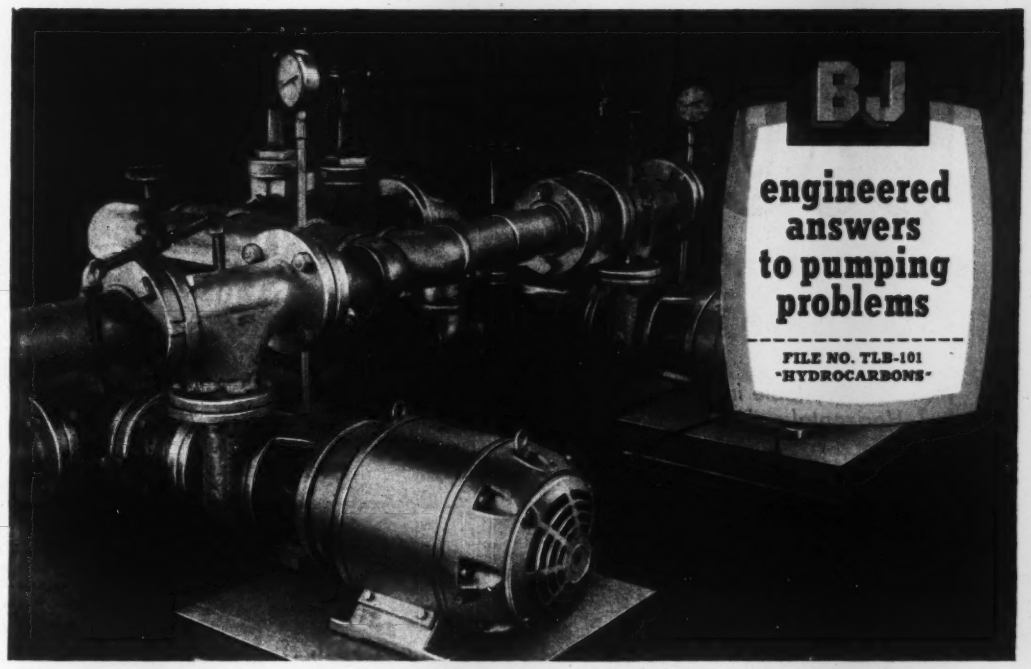

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The installation shown above is at General Petroleum's Bakersfield Bulk Plant. Two BJ Type TLB Pumps are used here for loading gasoline and diesel fuels, pumping 160 gpm against 62 ft. total head. Explosion-proof 3 hp, 3-phase, 60 cycle, 220/440 v motors operate at 3550 rpm.

For the engineered answer to *your* standard or special pumping needs contact your local BJ sales office or write direct. For more information on these TLB Pumps—including pump selection table and friction compensation charts—send the coupon below.

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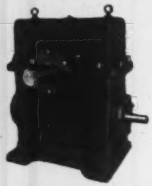
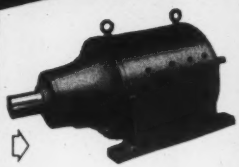
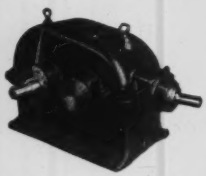


Type "H" Worm Gear



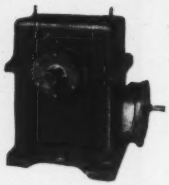
Straight Line Gear Reducer

Motorized Reducers

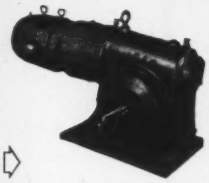


Spiral Bevel Herringbone

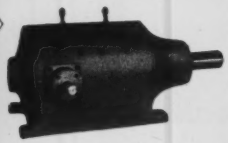
Double Worm Gear



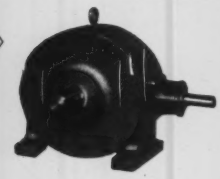
Helical Worm Gear



Motorized Worm Gear



Right Angle Gear Reducer



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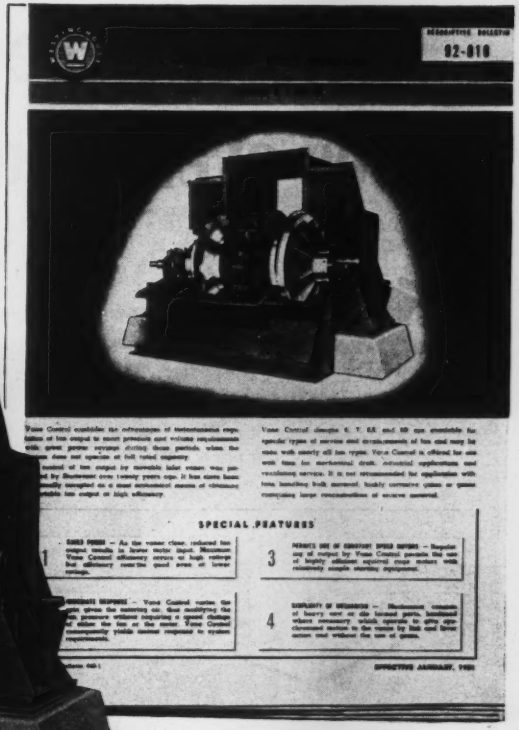

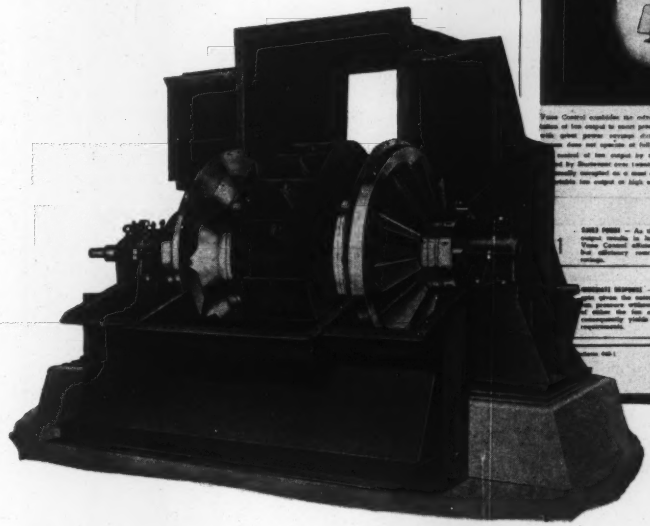

Cutaway of a Sturtevant Induced Draft Fan shows VANE CONTROL and the E-R (Erosion Resisting) Wheel.

Just off the press, Descriptive Bulletin DB 92-810 gives you complete information and data on the *new* Sturtevant Adjustable Inlet VANE CONTROL.

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J-80218

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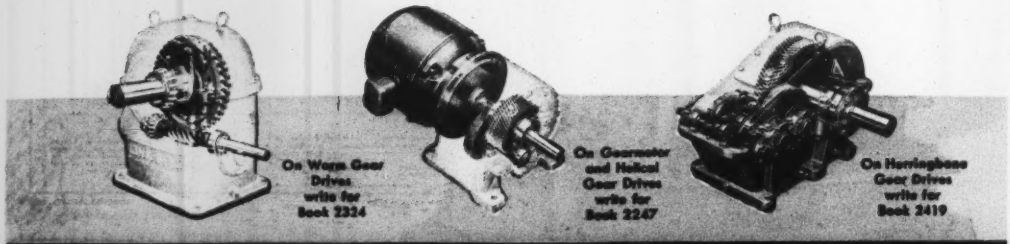
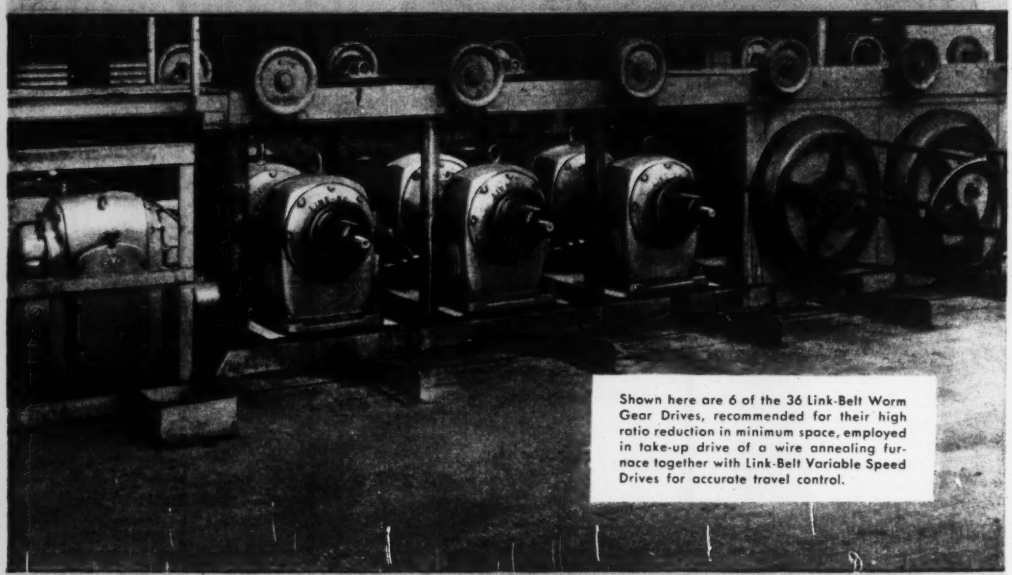

On Worm Gear Drives write for Book 2324
On Gearmotor and Helical Gear Drives write for Book 2247
On Herringbone Gear Drives write for Book 2419



Shown here are 6 of the 36 Link-Belt Worm Gear Drives, recommended for their high ratio reduction in minimum space, employed in take-up drive of a wire annealing furnace together with Link-Belt Variable Speed Drives for accurate travel control.

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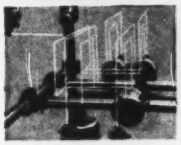

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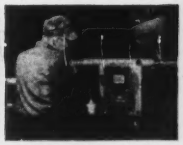

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"S" Monel's low coefficient of expansion, high density and corrosion resistance enable it to give excellent service where clearances are small and operating temperatures subject to considerable variation.

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valve seats	sleeves
impellers	ejector nozzles
wear rings	direct-acting pump liners

Mechanical Properties of "S" Monel*

(Age-hardened)

Yield Point	80-115,000 psi
Tensile Strength	120-145,000 psi
Elongation in 2-in.	4-1%
Hardness (Brinell)	300-375
Coefficient of Thermal Expansion (32°-212°F.) in. in °F.	.0000068

Hardness of "S" Monel at Elevated Temperatures*

(As-cast condition)

Temperature, °F.	Brinell Hardness
Room	321
700	321
800	311
900	311
1000	321
1050	335
1100	293

*Average properties—not to be used for specification.

Hardness: "S" Monel can be age-hardened to 300-375 Brinell. It retains this hardness even at elevated temperatures. (See table.)

Resistance to Galling: "S" Monel is superior to most other hard metals in its ability to resist galling under severe conditions of pressure and friction. Often where lubrication is poor or absent entirely, "S" Monel has shown unusual resistance to seizing.

Corrosion Resistance: "S" Monel is relatively unaffected by most commonly-encountered corrosives . . . reducing acids, organic acids, acid and neutral salt solutions, strong alkalies, dry gases, and most atmospheres.

Erosion Resistance: Because of high hardness and toughness, "S" Monel resists damage caused by cavitation, erosion, "wire drawing," and particle abrasion.

Machinability: "S" Monel can be machined as-cast, and preferably so when only a moderate amount of machining is to be done. For extensive machining, the castings may be softened to 235 Brinell by heat treatment. Subsequent heat treatments can restore hardness to the level of 300-375 Brinell.

Weldability: "S" Monel is *not* recommended as a weldable material.

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MECHANICAL ENGINEERING

Published by The American Society of Mechanical Engineers

VOLUME 73 NUMBER 6

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VOLUME 73
No. 6

MECHANICAL ENGINEERING

JUNE
1951

GEORGE A. STETSON, *Editor*

Review of ASME Papers

ONE of the problems that faced The American Society of Mechanical Engineers back in 1880 was what to do with the papers that had been presented at the first Annual Meeting. This problem was referred to the Publications Committee, one of the first to be appointed by the Council. The solution offered was the establishment of the ASME Transactions; and upon the Committee fell the responsibility of selecting from the papers presented at meetings those that were to be printed in that new publication.

Seven decades have passed since the first volume of Transactions was prepared. During that period the Publications Committee has continued to be responsible for the selection of papers printed by the Society. Expansion of the field of interest of the mechanical engineer and the increase in number of members, number of meetings held, and number of papers presented have necessitated elaboration, from time to time, of the procedure for the handling of technical papers set up in the early days of the Society. Although it remains unchanged in principle, the relatively simple process of review and selection of seventy years ago involves today many more committees and members, and hence there may be found in it practices and value judgments that appear not to be uniform. To expect several hundred reviewers, working as individuals, to exercise uniform value judgments is admittedly unrealistic.

In a pamphlet issued for the information of prospective authors and called "An ASME Paper," the course followed by a technical paper from the time it leaves the author's hands until it is published is shown on a flow chart. A similar chart appears in another Society pamphlet, "Know Your Society." In a message to members to be found on page 532 of this issue, J. Calvin Brown, president ASME, refers to this chart and outlines briefly how ASME handles its technical papers. The review of papers is a critical phase of this procedure and hence some further comment on it and on the consequences of reviewers' actions may be helpful.

Technical papers come to the attention of the Society in a number of ways. A few papers are solicited by program-making groups for presentation on a specific occasion or to round out a planned session. A majority of papers, however, are sent by their authors to the Society, or to some person or group representing it, in the hope that they will be accepted for presentation at a meeting and for publication. But regardless of whether a paper is solicited or is sent in by its author as a contribution to the literature of mechanical engineering, it is subjected to review before decision on presentation at a meeting or on publication is taken.

Review procedure is carried on by some forty professional divisions and committees which are the Society's program-making agencies. Some of these agencies have special review committees. In other agencies the executive committee itself acts as the review committee. In still others, no official review committee exists, but individual reviewers are selected for each paper as it is received. In general, regardless of the review organization of the agency, more than one person reviews a paper, particularly if the first reviewer's report is unfavorable.

The reviewers' decision may be to reject, accept, or suggest revision of the paper. Rejected papers are returned to their authors. Accepted papers, including those accepted after revision, are assigned to some meeting for presentation and discussion and are sent to the Secretary's office.

Whenever time permits, advance copies of ASME papers are prepared for sale and for use at the meetings where they are to be presented. Guided by the recommendations of the reviewers, the Publications Committee decides the form of the advance copies. If a paper is assigned to MECHANICAL ENGINEERING, Transactions, or the *Journal of Applied Mechanics*, advance copies will be printed from type in the format of the periodical in which they will ultimately appear. Advance copies of other papers are issued in mimeographed or similar form. Advance copies of ASME technical papers, regardless of form, are available for purchase by mail and at ASME meetings. Abstracts of these advance copies of papers appear in this magazine (see pages 512–516, for example).

It is obviously impossible to provide advance copies of a paper if the manuscript is not ready for processing several weeks before the meeting at which it is to be presented. Papers received too late to be preprinted may still be assigned for publication in Transactions or MECHANICAL ENGINEERING. If it is not so assigned, then only a brief condensation is published and the manuscript is filed in the Engineering Societies Library, from which photostatic copies may be procured.

Thus it will be seen that ASME attempts to provide advance copies of every paper that is to be presented at a meeting and to print in MECHANICAL ENGINEERING digests of all such papers. The advance copies are offered for sale. They are filed in the Engineering Societies Library. They are indexed by the Engineering Index Service, Inc. Hence if a paper has appeared on an ASME meeting program and the author has sent a copy of it to the Society, it should be possible to locate

it in later years by reference to the indexes of ASME publications or the Engineering Index; and the paper itself will be found either in one of the ASME publications, if it has been published in full, or in the Engineering Societies Library, if it has not.

From the foregoing explanation of how ASME handles its technical papers it should be apparent that critical decisions are made in two phases of the procedure outlined: (1) The decision of the reviewers to accept or reject a paper; which also involves a recommendation in respect to publication; and (2) the decision of the Publications Committee to assign the paper to one of the ASME periodicals or to issue it in some less permanent form. The degree of success of the ASME papers-handling procedure depends on these decisions and the decisions depend on the men who make them. No change in the procedure will eliminate the need for these decisions or for the men who are responsible for making them. A system is no better than the men who operate it. These men constitute an ever-changing group of several hundred ASME members who serve the Society without compensation other than the satisfaction the service itself brings to them. Contemporary and future readers of ASME papers can judge how competently these men do their work because the technical papers passed by them will forever be a part of the published literature of engineering. Criticism of their judgment is sometimes heard. Their anonymity saves them as individuals from the direct sting of such complaints. It also makes it difficult to give them as individuals the praise and credit that is their due for their services as reviewers of ASME papers.

For Civil Defense

EARLY in May The American Society of Mechanical Engineers was one of 300 national organizations having a combined membership of some 50 million citizens to be represented at a Civil Defense Conference in Washington conducted by the Federal Civil Defense Administration.

Federal Administrator Millard Caldwell called the conference to mobilize civil leadership of the Nation "to spearhead a program of education for national survival." The two-day meeting, which included a dinner addressed by the President of the United States, consisted of a number of forums at which were discussed such topics as Civil Defense organization; technical services (engineering, rescue, police, fire, warden, transportation, self-protection); health, emergency welfare, and special-weapons defense; the problem of civil-defense information and the role of national organizations; operational services (shelter, supply, warning, communications); the role of the military in civil defense; and training of civil-defense personnel. All in all, the national gathering was intended to stimulate interest and enthusiasm for civil defense in the persons attending the conference in the hope that they would carry back to their organizations and communities the substance of the important information communicated to them.

The Federal Civil Defense Administration was established under Public Law 920, known as the Federal Civil Defense Act of 1950, as an independent agency within the Executive Branch of the Government. The act also created a Civil Defense Advisory Council of 12 representatives of Federal, state, and local governments. It is the function of FCDA to engage in basic planning, to give information to the states, pay a part of the cost of equipment and shelters, and provide some kinds of emergency supplies. Operation of civil defense, however, is not a Federal but a state and local affair.

It has recently been reported that 27 states have concluded or are processing mutual aid pacts. Communities large and small have completed or are organizing local civil-defense programs. A local defense organization requires a great many trained people: health workers, rescue crews, engineering squads, welfare workers, fire fighters, truck and car drivers, mechanics, and staff workers. There is a job for every physically and mentally qualified person.

Education of the public on self-protection and what to do in case of attack is one phase of a tremendous task which faces every community. Training of the civil-defense workers in their special jobs is another phase of this task. To aid in preparing for and conducting essential educational and training programs in local communities there are available, through National Defense, motion pictures, radio and television programs, speakers, and consultative advice.

Announcement is expected soon of official FCDA standards and specifications for air-raid shelters. It was recently reported in the FCDA newsletter *Alert* that these standards are to be based on research begun immediately after World War II, including a study by the Army Corps of Engineers at Lehigh University.

Civil defense is a vast project which involves millions of people and every community in the nation. Engineers have a personal as well as a patriotic duty to perform in assuming positions of leadership in this project in the areas where they reside. For many this will be the daily job of keeping utilities going.

Keep the Pipeline Full

DURING the month of May the Engineering Manpower Commission of EJC issued its Bulletin No. 1 under the title "Utilizing Engineering Manpower." The Commission is concerned with the maintaining an adequate supply of engineers and scientists and the use of such men at their highest efficiency. Convinced that the nation is likely to be in a state of military preparedness for many years, the Commission urges that we "keep the pipeline full." This means that a sufficient number of young people must pass into and through the engineering colleges, that they must be properly absorbed and further trained for and by industry, and that such persons must be utilized to the best advantage. The current bulletin describes "deferment procedures" to be used by employers "to maintain the industrial might of the nation."

Some INDUSTRIAL EXPERIENCES *With* SYNTHETIC LUBRICANTS

By C. H. SWEATT and T. W. LANGER

CARBIDE AND CARBON CHEMICALS COMPANY, TONAWANDA, N. Y.

INTRODUCTION

WHILE conventional petroleum lubricants give satisfactory service in the majority of industrial applications, they possess recognized limitations under certain operating conditions. Therefore, synthetic lubricants are utilized currently in many cases because of unique or superior performance characteristics (1, 2).[1] Advances in design and engineering practices will undoubtedly expand their use (3).

Several types of synthetic lubricants differing in chemical structure and properties are now available commercially and new products are being developed (4). The fluids discussed in this paper are polyalkylene glycols and their derivatives. These lubricants range in consistency from very light to highly viscous liquids. Members of the 50-HB and 75-H series are water-soluble while the others, including the LB series, are substantially insoluble in water. Since their physical and chemical properties have already been discussed extensively in the technical literature (5, 6, 7), only a few of the most pertinent properties of the synthetic lubricants mentioned in this discussion are summarized in Table 1.

The introduction of polyalkylene-glycol lubricants created an immediate commercial interest in a large variety of industries (8). Many difficult lubrication problems have been solved by means of their unusual properties which include excellent antiwear action, good load-carrying capacity, favorable viscosity-temperature relationships, low stable pour points, little or no solvent and swelling effect on both natural and various types of synthetic rubber, stability at elevated temperatures, and unusual resistance to sludge and varnish formation. A number of specific practical and successful experiences under widely different operating conditions will be described in this paper.

HIGH-TEMPERATURE APPLICATIONS

If industrial lubrication problems are considered from the standpoint of operating conditions, those involving unusually high temperatures are probably the most difficult to solve with conventional lubricants. The oxidation and thermal decomposition of hydrocarbon oils under the influence of excessive heat is well known and resulting deposits of sludge and carbon frequently cause high wear or otherwise interfere with the proper operation of the equipment involved. The increased maintenance and repair costs under such conditions are often considered to be the inevitable penalty of high-temperature operation. In some cases, however, the use of polyalkylene-glycol-type synthetic lubricants will reduce this expense because of two unusual characteristics: (*a*) They tend to be somewhat more stable at elevated temperatures; and (*b*) when they do undergo thermal and oxidative decomposition, the resulting products are fluids similar in character to the original lubricant or volatile materials which pass off without leaving tarry or carbonaceous residues.

TABLE 1 TYPICAL PROPERTIES OF REPRESENTATIVE SYNTHETIC LUBRICANTS

Product identification	Viscosity at 100 F, Saybolt Universal seconds	Viscosity index	Pour point, deg F	Flash point, deg F
50-HB-280-X	280	150	—35	500
50-HB-400	400	149	—35	430
50-HB-660	660	144	—30	430
50-HB-5100	5000	...	—20	450
75-H-90000	90000	...	40	485
LB-70-X	70	78	—65	325
LB-135	135	148	—55	300
LB-140-X	140	140	—50	345
LB-170-X	170	144	—45	440
LB-300-X	300	142	—40	490
LB-385	385	144	—35	430
LB-550-X	550	141	—25	490
LB-1145	1145	137	—20	430
LB-1200-X	1200	136	—15	490
DLB-50-B	50	150	below —70	350
Fluid-818	67	115	below —70	395

NOTE:

Solubility: Members of the 50-HB and 75-H series are completely soluble in water at room temperature; the other fluids are not soluble in water.

Inhibitor: "X" indicates presence of the standard oxidation inhibitor. Presence of other additives is shown by "Y" followed by a number identifying the particular material.

Specific Gravity: For the fluids listed, the specific gravities are close to unity, ranging from 0.95 to 1.10.

When mass-production methods involve the processing of a product at high temperatures, a lubrication problem frequently exists in the materials-handling equipment. This is particularly true in the glass and ceramics industries where the polyalkylene-glycol lubricants have found a variety of uses. One of these is in the lubrication of wheel bearings on the rail cars which carry ceramic products through long tunnel kilns (9, 10). An eastern ceramic plant has such a unit that is 400 ft in length and contains 59 loaded kiln cars of the type shown in Fig. 1. Approximately every 40 min, a freshly loaded car is pushed in at one end and a load of fired ware comes out the other. Each 6400-lb car is in the kiln for 37 hr, during 22 of which the product is exposed to a temperature of 2250 F. Although the car wheels are protected from this intense heat, the roller bearings operate at 400 to 500 F. When these bearings were lubricated by means of a hand-operated grease gun with a mixture of mineral oil and graphite, sludge and carbon deposits frequently caused seizures which made it impossible to move the cars through the kiln. When this occurred, two maintenance men were required to jack up the faulty car and install clean bearings. Four or five such breakdowns were often experienced in a single day.

Since substituting LB-550-X for the petroleum oil in this application, as much as 5 months of operation have been ex-

[1] Numbers in parentheses refer to the Bibliography at the end of the paper.

Contributed by the Petroleum Division and presented at the Annual Meeting, New York, N. Y., November 26–December 1, 1950, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

FIG. 1 WHEELS OF CERAMIC KILN CARS ARE EXPOSED TO HIGH TEMPERATURES FOR MANY HOURS
(The use of a polyalkylene-glycol-type synthetic lubricant in roller bearings eliminated seizures and reduced maintenance costs in a large eastern plant.)

TABLE 2 COMPARATIVE PERFORMANCE AND COST DATA—LUBRICATION OF KILN-CAR WHEEL BEARINGS

	Using mineral oil plus graphite	Using LB-550-X plus graphite
Number of applications per week	6 to 8 (two per trip)	one
Weekly lubricant consumption, oil	65 gal	10 gal
graphite	36 lb	5 lb
Weekly lubricant cost	$45.00	$25.00
Number of bearing seizures	4 to 5 per day	none in 5 months
Labor cost to free seized bearings	$35.00 per week	none
Total savings in direct labor and materials	$55.00 per week	
Indirect savings reported	Reduced car handling time lower car overhaul costs improved labor relations	

perienced without a wheel-bearing lubrication failure. As indicated in the comparative data presented in Table 2, it has been found necessary to oil these bearings only once each week instead of twice during each trip through the kiln, thereby cutting the weekly lubricant requirement from 65 gal of petroleum oil and 36 lb of graphite to 10 gal of LB-550-X and 5 lb of graphite. This reduction in lubricant cost plus the elimination of maintenance time to free stuck cars represents a total saving of $55 per week in direct labor and materials. The cost of overhauling the kiln cars has also been reduced, since the wheel bearings are in better condition at the periodic inspections, and cleaning the bearings has been greatly simplified. An indirect benefit reported by the plant superintendent is an improvement in labor relations. Formerly as many as seven men were sometimes required to move a car after it had emerged from the kiln, and there were many complaints regarding the effort required to push the cars through the plant. They can now be handled by two men with little difficulty.

The practical advantages of the polyglycol synthetic for this application have also been reported by a Midwestern ceramic producer. In this case, the LB-550-X and graphite mixture is sprayed into the kiln-car bearings with a small air pressure lubricator. Using $\frac{1}{2}$ lb of synthetic graphite per gal of LB-550-X, a pint of the mixture lubricates 40 wheels at a cost of 6.5 cents per car per trip through the kiln. While this is slightly higher than the cost of petroleum-oil lubrication, the difference is considered negligible in comparison with the savings made possible by the new fluid. A former maintenance expense of approximately $2 per car per month has been eliminated completely. After 8 months of operation on LB-550-X, wheels were removed from one car and found to be clean and free of carbon. Since all of the cars moved very easily on the tracks, it was assumed that the rest of the bearings were in the same excellent condition, and operation was continued without further inspections.

A continuous record of wheel bearing friction is maintained in this plant by means of a pressure recorder on the hydraulic mechanism which pushes the cars through the kiln. While mineral oil was still in use, the pressure needed to move the cars was never less than 100 psi and reached a peak of 190 psi at times. After changing all the wheel bearings over to the synthetic lubricant, the pressure dropped to values between 50 and 70 psi, with an average of 60 psi being typical of daily operation. Whereas formerly two men were often needed to move some of the cars after they emerged from the kiln, it has been possible for one man to push as many as fourteen loaded cars since the change-over. The clean burnoff characteristic of the synthetic oil is believed to be primarily responsible for its success in this application.

The LB type fluids are also being used successfully by several light-bulb and radio-tube manufacturers for the lubrication of hot flare cutoff and stem machines. One company using LB-550-X in thirty such units reported that in the first 10 months following adoption of the synthetic oil, not one machine had to be shut down for the removal of carbon deposits. This had been necessary at intervals of from 2 to 4 weeks with the former lubricant. Glass fabricators have found these synthetic oils useful in lehr outboard bearings, on the gears and chain drives of annealing ovens, and in the lubrication of hot-glass cutoff shears. In some cases, the polyglycol fluids are used only intermittently to clean out gum and carbon deposits which are left by conventional lubricants.

In applications involving the operation of ball bearings at high temperatures, varnish and carbon deposits frequently cause high wear and premature bearing failures. Considerable data are available from actual service tests which indicate that the use of synthetic lubricants will alleviate this type of difficulty. For instance, in a large fan used to circulate 630 F air around a drying chamber, the original bearings failed 10 days after the new machine was placed in operation in a chemical plant. Carbon deposits found on the balls of the badly worn

bearings were believed responsible. After changing to another highly recommended petroleum product, failure occurred in 12 days. LB-170-X was then tried, and the third set of bearings had been in operation for 15 months with no sign of trouble at last report.

Before leaving the subject of high-temperature lubrication, mention should be made of an experience in a certain type of packaging equipment used in the dairy industry to fill vinyl-coated milk cartons. A machine has been recently developed which automatically fills and seals these containers at the rate of nearly 4000 cartons per hr. Initial performance was impaired, however, by excessive carbon deposits which formed at frequent intervals on the hot-sealing mechanism where temperatures of 400 to 450 F are encountered. Various hydrocarbon oils were tried without success. Following experiments with the synthetic fluids, LB-550-X has been specified as the lubricant for all moving parts of the sealing heads in the several machines of this type now in operation in different parts of the country. One dairy recently reported that this fluid has been in service for 19 months with exceptionally good results and that it was the only lubricant found satisfactory for use in this particular application.

Their thermal stability and resistance to sludging make the polyalkylene glycols useful as heat-transfer media in both laboratory and industrial equipment at temperatures from 300 to 500 F. For instance, a manufacturer of electrical products found it necessary to shut down and completely clean certain oil baths every 4 to 5 months when operating at 200 to 400 F with the best available hydrocarbon oil. In the first trial, 50-HB-280-X was used for 7 months in a unit which had not been cleaned at the start of the test. The fluid was in good condition when drained and it had dissolved the gum and sludge deposited by the previous liquid. The plant is now using the synthetic with a 12-month drain schedule, and finds the heaters and controls to be essentially clean at the end of this period. Other advantages of these synthetics as heat-transfer media are ease of circulation on starting, the speed of reaching thermal equilibrium, and little change in viscosity during service. Additional high-temperature uses for these fluids include the lubrication of chains and conveyers in various types of heat-treating and baking ovens and the impregnation of asbestos packings for high-pressure steam service.

GEAR LUBRICATION

Some of the most interesting examples of the manner in which the unusual antiwear properties of the polyalkylene-glycol lubricants may contribute to the solution of industrial lubrication problems have come from applications involving heavily loaded gears. Comparative data are available, for instance, from carefully controlled tests recently completed by a chemical manufacturer in heavy-duty speed reducers coupling 75-hp electric motors to rotary pumps. Using a Specification 2-105-B petroleum oil, the bronze ring gears, which are driven in these units by alloy-steel worms, suffered severe pitting and spalling at the tooth surfaces as illustrated in Fig. 2. This particular gear required replacement after 6 months of operation, at which point the mineral oil had become jet black in color and numerous metal particles were found in the bottom of the casing. After thorough cleaning and the installation of a new gear, this unit was serviced with LB-1200-X. Inspection following a year of satisfactory operation during which only 2 qt of make-up oil were added revealed the new bronze gear to be in the condition shown in Fig. 3. There was only a trace of the tooth face pitting which had caused failure in one half the time with mineral oil, and other parts of this speed reducer were in excellent condition. The used lubricant had

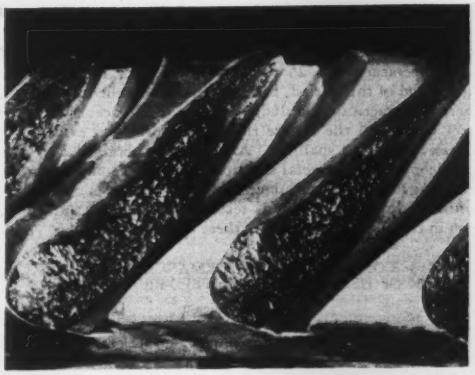

FIG. 2 TOOTH SURFACES OF A BRONZE GEAR FROM A 75-HP SPEED REDUCER ARE SPALLED AND PITTED AFTER 6 MONTHS OF OPERATION WITH A SPECIFICATION 2-105-B GEAR OIL

FIG. 3 ONLY A TRACE OF PITTING APPEARS ON TOOTH FACES OF AN IDENTICAL GEAR AFTER 12 MONTHS OF COMPARABLE SERVICE USING LB-1200-X AS THE LUBRICANT

the appearance of new oil and there were very few metal particles in the case. Another series of tests conducted concurrently in an identical unit gave similar results. The use of the synthetic lubricant has at least doubled the life of the bronze gears in these speed reducers, thereby accomplishing a considerable saving in overhaul costs, down time, and replacement parts. Since there was less leakage at the packing glands, routine servicing and the frequency of oil additions have also been reduced.

In another type of speed reducer also involving a steel worm driving a bronze gear, a textile plant experienced very high wear, excessive sludge formation, and severe carbonization with various petroleum products. In these heavily overloaded units it was necessary to overhaul each speed reducer at 3-month intervals, including extensive cleaning and the installation of new ball bearings, worms, and ring gears. Even with this rigorous maintenance schedule, frequent failures were encountered between overhauls. As indicated by the comparative performance data summarized in Table 3, the synthetic lubricant

has been extremely helpful in this application. The initial test using LB-1200-X in one of these units gave 15 months of satisfactory operation and it was noted that both bearing and oil temperatures ran 25 to 35 F lower with the synthetic. At the end of this period, bearings were in excellent condition, there was practically no sludge, and the tooth faces of both the steel worm and the bronze ring gear showed no evidence of excessive wear or spalling. After having obtained the same excellent results in several additional tests, this company is now changing more than one hundred of these machines over to the synthetic lubricant. This is resulting in a significant reduction in the cost of maintaining these speed reducers.

TABLE 3 COMPARATIVE PERFORMANCE DATA—LUBRICATION OF HEAVILY LOADED SPEED-REDUCER GEARS

	Using petroleum lubricant	Using lubricant LB-1200-X
Overhaul schedule	Every 3 months	Every 12 months
Failure between overhauls	Frequent	None
Tooth surfaces at overhaul point	Bronze gear badly worn, worm teeth spalled	Very little wear, no spalling
Deposits at overhaul point	Heavy sludge in case, ball bearings loaded with hard carbon	Practically no sludge, ball bearings in excellent condition

Fluids of the 50-HB series have also been used to advantage as gear lubricants. One of the heavier grades having a viscosity of approximately 5000 SUS at 100 F alleviated difficulties experienced in a plastics plant with the lubrication of steel pinion gears in a 4-roll calender operating at high temperatures. The previously used lubricant tended to run off the tooth surfaces, and, after as little as 3 weeks of operation, excessive sludge deposits and spalling of the pinion gear teeth occurred. The 50-HB-5100-X was found to adhere more tenaciously to points of contact and to be more resistant to thermal decomposition. After several times the service life usually obtained with mineral oil, the tooth faces showed no signs of deterioration. This tendency of the higher-viscosity synthetic lubricants to resist throwoff from metal surfaces has proved valuable in the lubrication of large open gears.

To further illustrate the load-carrying ability of these fluids in a very familiar application, LB-300-X was used in both the transmission and the differential of a laboratory test car. After 135,000 miles of operation, the gears were found to be in very good condition. The lubricant in this hypoid differential was changed only three times in this period and the transmission oil was not changed at all. Performance was entirely satisfactory, and inspection revealed the gears and bearings of both units to be in excellent condition at the end of the test.

The reduced wear and extended tooth life which frequently result from the use of the polyglycol lubricants with heavily loaded gears suggest that these fluids possess basic lubricity characteristics which differ considerably from those of mineral oils. Under certain conditions they display unusually high film strength or load-carrying qualities which appear to be inherent in their structure. While the exact physical or chemical mechanism responsible for this phenomenon is not clearly known, its existence may be demonstrated readily in accepted bench-type lubricant testing equipment (11). For instance, in a modified wear test which has been developed using the SAE machine, two Timken bearing races or "test cups" are rotated at different speeds while being held against each other by a constant load, thus simulating the combined rolling-rubbing action of hypoid gear teeth. This test is of 15 hr duration, and the lubricant temperature is cycled between 200 and 250 F at 15-min intervals. At the selected speed, load, and rubbing ratio, almost immediate scoring occurs with uncompounded minerals oils, while some petroleum products containing effective extreme-pressure additives will complete the test with very little wear. Lubricants are evaluated on the basis of the weight losses of the test cups and the final condition of the contacting surfaces. While originally developed to correlate with the CRC high-torque axle test for automotive-gear lubricants, this procedure measures a basic lubricity characteristic which may influence success or failure in many industrial applications. Typical results obtained with various types of petroleum and synthetic lubricants in this bench test are presented in Table 4.

TABLE 4 15-HR MODIFIED SAE TEST RESULTS

Lubricant		Weight loss of test cups (mg)
SAE-30 motor oils:	Midcontinent	Scored in less than 1 hr
	Coastal	Scored in less than 1 hr
	Pennsylvania	Scored in less than 1 hr
Automotive transmission lubricant		68 (1-hr test)
U. S. Army Spec. 2-105A Gear Oil		4825 (8.5 hr)
U. S. Army Spec. 2-105B Gear Oil		12
Lubricants LB-70-X		Scored in less than 1 hr
LB-170-X		Scored in 7.5 hr
LB-300-X		14
LB-550-X		15
LB-1200-X		30
Lubricant LB-140-X plus 2-105 B-type extreme-pressure additive		5
Test conditions:		
Speed, rpm		470
Load, lb (scale)		135
Oil supply, cc per hr		33
Rubbing ratio		3.4:1
Duration, hr		15
Break-in, min (at 25 lb)		15

It may be seen that straight mineral oils as well as some specially inhibited petroleum-base gear oils do not have the antiwear characteristics required by this procedure, while the uncompounded LB-type lubricants having viscosities of 300 SUS at 100 F or higher complete the test with low wear values. This inherently superior film strength in combination with excellent high-temperature stability is believed to be one of the factors responsible for performance experienced with the polyalkylene-glycol lubricants in many industrial applications. It is likely that the continued research on synthetic lubricants will contribute to a better fundamental understanding of boundary lubrication.

As shown in Table 4, a low-viscosity LB fluid gave excellent results when compounded with a standard extreme-pressure agent. Other types of additives may also be employed to enhance the suitability of these synthetic lubricants to meet special requirements. However, their solubility and performance properties may differ somewhat from those obtained in mineral oils.

METALWORKING APPLICATIONS

The good extreme-pressure properties of the polyalkylene-glycol lubricants have been evident in certain metalworking operations, being reflected in prolonged tool life and better surface finish. Table 5 lists examples of the improved performance which has been obtained in four different plants.

At times ease of removal or suitability for further processing without cleaning is the principal advantage of the synthetic lubricant. In a plant using a 20 per cent solution of a 50-HB fluid, it was found that tool life and surface finish were good; furthermore, the parts could be cleaned readily prior to enameling, whereas other oils caused many rejects because of imperfect bond. Rusting had occasionally been troublesome with the regular soluble oil emulsion, but the presence of a special additive in the synthetic lubricant imparted sufficient antirust quality to protect the parts when stored between operations.

TABLE 5 POLYALKYLENE-GLYCOL-TYPE FLUIDS IN METAL-WORKING

Description of operation	Comparative performance	
	Conventional oil	Polyalkylene - glycol-type fluid
Drawing of 85–15 brass	5000 parts. Die needed cleaning and buffing. Some tarnish over week end	17000 parts with LB-135. Die still satisfactory. No tarnish. Reduced gumming in degreaser
Deep drawing of sheet iron	50 pieces between tool dressings	250 pieces between dressings with 50-HB-660
Blanking and pressing annealed spring steel	35000–50000 pieces between tool dressings	100000–120000 pieces between dressings with a 25 per cent 50-HB-660 aqueous solution
Drawing nickel-plated steel shells	25000–30000 pieces before scratches appeared and die had to be reconditioned	Run of 65000 pieces completed with no scratches. Die still satisfactory using a 25 per cent 50-HB-660 aqueous solution

In another instance it was necessary to lubricate aluminum parts before assembly and then remove the lubricant to permit brazing. Bad warping was experienced on attempting to burn off the residual lubricant. The problem was solved by lubricating with a 50-HB synthetic and water washing. When working silver and 85-15 brass with polyglycol lubricants, it has been found possible to solder without cleaning. After annealing parts from this process the appearance was noticeably better than when cleaned in the conventional operation. In lapping stainless-steel threads with glass or diamond dust, superior finish has been obtained with the polyglycol fluids. Rolling of nickel-silver, copper, sterling silver, brass, and aluminum has been accomplished with good finish and freedom from stains. In connection with their use in metal-working, it seems pertinent to mention that the polyalkylene-glycol fluids are essentially nonirritating as evidenced by their use in hairdressing compounds.

The cleanliness, ease of removal, stability, and good lubricating properties of the polyalkylene-glycol fluids have also proved useful in the textile industry where they are being used alone, and in formulations for lubricating or conditioning various fibers—including nylon, glass, wool, and rayon (12).

MOLD-RELEASE AGENTS AND RUBBER LUBRICATION

In view of the little solvent and swelling effect of the polyglycol fluids on most natural- and synthetic-rubber compositions, they are being used extensively in mold-release formulas and as lubricants for tire air bags, seals, gaskets, knives, and other cutting tools in the fabrication of elastomers. Both the water-soluble (50-HB) and water-insoluble (LB) series are employed, depending upon conditions and preference of the manufacturer. In most cases the lubricant is diluted with a solvent and may contain other ingredients such as wetting agents, fine-particle solids, glycerol, or silicone emulsions. The benefits which have been observed are longer life of air bags, cleaner breakaway and insignificant build-up on the mold, and more nearly perfect formation of such products as stencils, rubber stamps, battery tops, and O-rings.

COMPRESSOR AND VACUUM-PUMP LUBRICATION

In some chemical processes even minute contamination by oil is objectionable because of possible catalyst poisoning or detrimental effect on the product. Hydrogen compressors are operated with polyglycol lubricants since the insignificant sulphur content of the LB and 50-HB fluids results in better maintenance of high hydrogenation reaction rates. Traces of sulphur compounds from ordinary lubricants are thought to reduce the activity of the catalyst involved. Moreover, the normal degradation products of the synthetics are volatile compounds which do not foul the catalyst. In a textile plant, vacuum pumps which were lubricated with conventional oils required an average of 25 to 30 man-hours per week to maintain operations. Small amounts of carbon disulphide from the material being handled apparently promoted excessive gumming and carbonization, especially around the piston rings. Use of LB-300-X eliminated the need for frequent overhaul and the useful life of the lubricant was increased approximately fourfold. These are illustrations of the benefits that may be realized from the different chemistry of synthetic lubricants.

Physical behavior as well as chemical reactivity may be involved in pump lubrication. In an air compressor it proved impracticable to remove the last traces of oil entrainment by any reasonable means, and even a small amount of oil mist gradually retarded a subsequent catalytic oxidation process. By using 50-HB-280-XY-23-D and following with a water wash, it was possible to scrub the air free from objectionable lubricant carry-over, thereby eliminating fouling of the catalyst. In another factory, formation of ice on a piston rod in a low-temperature liquid pump shortened the life of the packing when using mineral oil. Application of synthetic lubricant eliminated the ice formation and greatly prolonged packing life. At still another plant personnel working in the vicinity of vacuum pumps lubricated with SAE-50 petroleum oils complained of obnoxious "smoking." It seemed that a fine spray or mist was carried over. This situation was remedied by use of 50-HB-5100.

Even where contamination is not a problem, the polyglycol fluids have been used in compressors and vacuum pumps because of their high-temperature stability and freedom from carbonaceous residues. They also act as solvents for various organic deposits. For example, in a coffee-packaging machine a synthetic lubricant is being used in the vacuum pump because it dissolves the coffee gums which would otherwise interfere with proper mechanical operation. In another instance there was excessive thickening or sludging of petroleum oils in the vacuum pumps used to evacuate autoclaves engaged in curing methacrylate plastic articles. LB-170-X corrected this condition presumably on account of the solubility of the polymer in the fluid.

INTERNAL-COMBUSTION-ENGINE LUBRICATION

The good lubricating quality, cleanliness characteristics, and solvent action of the polyglycol fluids for petroleum residues have been used to good advantage in internal-combustion engines (13). Industrial tow and lift trucks are especially prone to form sludge with mineral oil. The comparative experience of one company is summarized in Table 6. It was found necessary to overhaul engines after 5 to 6 months of operation when using premium-grade oils on account of badly stuck rings, high oil consumption, and excessive smoking. Instead of overhauling one 4-cylinder engine when it reached the repair stage at 6 months, an LB fluid was installed. This charge promptly became dirty upon dissolving the preformed sludge and the lubricant was drained twice during the next 2 weeks. At first the consumption of synthetic lubricant was approximately the same as that of the previous oil, namely, about 2 qt per day, but, within 1 week, the consumption dropped to approximately 1 qt per 48-hr week. The lubricant was changed only twice a year thereafter; however, the filter was changed regularly whenever the lubricant began to appear dirty. After 30 additional months of satisfactory service, repair was necessary due

TABLE 6 COMPARATIVE PERFORMANCE IN TOW- AND LIFT-TRUCK SERVICE

	Using premium-grade oil	Using polyalkylene-glycol-type lubricant
Average overhaul period, months	5 to 6	Over 27
Wear of rings, cylinders and bearings	Normal	Normal
Ring sticking at overhaul	Excessive	None
Cleanliness at overhaul	Badly sludged	Slight deposit in pan and valve chamber
Smoking	Obnoxious as need for overhaul approaches	Negligible throughout service
Lubricant change period, weeks	1	26 to 52
Lubricant make-up	Increases to 2 qt per day by 6-mo overhaul period	Averages approximately 1/2 pt per day at start and still less than 1 qt per day at 27–30 months

to mechanical failure. The engine appeared to be unusually clean on dismantling. Wear was normal for 3 years of start, stop, and idling service. Pistons, rings, and connecting-rod bearings from this engine are shown in Fig. 4, after 6 months on mineral oil and 2 1/2 years of additional service with synthetic lubricant in the crankcase. Five other similar tow and lift trucks have been operating for 27 months on LB-170-X or LB-300-X, with only one other overhaul job being necessary. This company also benefited from easier starting in winter and no oil "smoke" in the factory.

In various types of small two-cycle engines where a fuel-lubricant mixture is used, the clean burnoff and negligible ash content of the polyglycol fluids have proved to be especially beneficial. Reported advantages include reduced gumming and less fouling of ports and spark plugs. This in turn results in greater power output and prolonged engine life. For example, in model airplane engines higher speeds have been obtained as shown in Table 7.

TABLE 7 IMPROVEMENT IN MODEL AIRPLANE-ENGINE OPERATION

	Average speed at fully opened throttle, rpm
Commercial fuel containing castor oil	9000
Mixture of methanol and lubricant 50-HB-660	10040

Further consideration is being given to the use of the LB and 50-HB lubricants in outboard motors, lawn mowers, and similar service.

SYNTHETIC GREASES

Several different lubricating greases have been prepared using polyalkylene-glycol lubricants as the liquid components, as shown in Table 8.

Many interesting applications have been developed for these greases, which usually have a consistency corresponding to the NLGI No. 2 grade. In dry-cleaning equipment HT-1256-A gave longer service than conventional greases, apparently because of good high-temperature stability and greater resistance to disintegration by the solvents. In another application, bolts on plastic extruder dies operated at elevated temperatures were very easy to turn when the threads were lubricated with HT-1256-A containing 10 per cent molybdenum disulphide. Grease SLB-400-A-10 is being used on hot surfaces because it does not melt.

While not actually a grease, a very high-viscosity 75-H fluid has proved to be an excellent long-lasting lubricant for rubbing surfaces of push-button units. Lubricant 75-H-90,000 was found to be the best material for stopcocks in an oil-testing system operated at 165 F. The tackiness and extremely high viscosity of this type polymer provide greaselike characteristics without the use of thickening agents.

TABLE 8 GREASES FROM POLYALKYLENE-GLYCOL-TYPE SYNTHETIC LUBRICANTS

Identification of grease	Base fluid viscosity at 100 F, SUS	Jelling or thickening agent	Dropping point, F	Principal function or advantage
818	67	Lithium soap	365	Useful over wide temperature range (—90 to 250 F)
GP-135	135	Lithium soap	375	General-purpose grease with low-rubber-swell quality
HT-1256-A	1145	Lithium soap	402	High - temperature stability
WS-400	400	Sodium soap	324	Water solubility
SLB-400-A-10	385	Fine-particle silica	Above 500	Ability to stay on hot surface

INKS, PLASTICIZERS, DETERGENTS, AND DEFOAMING AGENTS

Some industrial applications of the synthetic fluids depend largely upon their surface behavior or solubility. In one plant

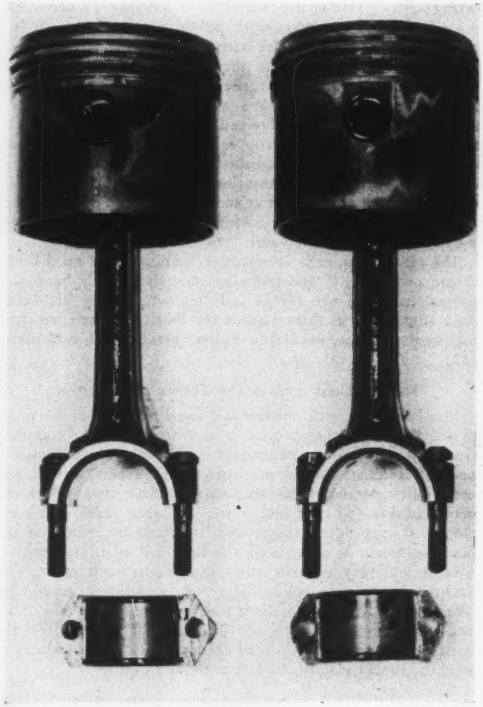

FIG. 4 PISTONS FROM AN INDUSTRIAL LIFT-TRUCK ENGINE ARE UNUSUALLY CLEAN AFTER REACHING THE USUAL OVERHAUL POINT OF 6 MONTHS WITH CONVENTIONAL OIL AND THEN RUNNING FOR 2 1/2 YEARS WITH A "UCON" LUBRICANT IN THE CRANKCASE

where an ink containing ordinary oils was used for printing on inexpensive porous paper, it was necessary to stop operations every 2 hr to clean the adhering fibers from the rolls. When a low-viscosity LB product was substituted for the oil the press ran more than 50 hr without a shutdown. A mimeograph ink containing LB-1145 was found superior on the basis of leaving a dry stencil and no leakage.

Leather gaskets are impregnated with polyglycol fluids to get desirable feel, appearance, resilience, and service. Incorporation of small amounts of these synthetic lubricants enhances the effectiveness of some ordinary detergents. Increasing quantities of 50-HB and LB lubricants are being used as antifoam agents and demulsifiers in many different media and as chemical intermediates to prepare such compounds. The defoaming action in aqueous systems may be related in part to the fact that the 50-HB fluids are completely miscible with water at ordinary temperature but become sparingly soluble as the temperature is raised moderately. These examples show that the different surface properties or solubility characteristics of synthetic lubricants can be a definite asset in practical usage.

HYDRAULIC FLUIDS

Synthetic lubricants are proving to be superior hydraulic media or components of hydraulic fluids because of favorable viscosity-temperature characteristics, good stability, or other desirable properties (14). Large volumes of polyalkylene-glycol products are being used in automotive hydraulic-brake fluids, brake-parts dunking compounds, and industrial hydraulic operations (15, 16). When starting on a cold day a precision grinder required 4 to 5 hr to reach rated capacity and accuracy with the usual hydraulic fluid, while after changing to LB-140-X the rated speed and finish were achieved in $^1/_2$ hr. In outdoor instruments the need for seasonal change or heating in winter has been eliminated by switching from the former oil to LB-300-X. Similarly, these lubricants are giving outstanding service in door closers and other damping devices. In a special instrument operating at extremely high pressure it was found that some hydraulic fluids acted as solids for all practical purposes at or below 150,000 psi. On the other hand, DLB-50-B remained sufficiently fluid at this high pressure to permit satisfactory performance.

The synthetic lubricants have proved to be very stable in hydraulic service. A hydraulic welding machine required change of SAE-10 petroleum oil about three times per year because of the voluminous amount of sediment and sludge which accumulated in the system. With LB-140-X this same system was clean and free of sediment after one year of operation. As a further example of unusual stability, LB-300-X was found to be in excellent condition after 3 years of continuous use in a 500-ton hydraulic press as indicated by the data in Table 9.

TABLE 9 ANALYSIS OF USED SYNTHETIC HYDRAULIC FLUID FROM 500-TON PRESS

	Polyalkylene-glycol-type synthetic lubricant, LB-300-X	
	Typical values on new sample	On sample after 3 years' use in 500-ton hydraulic press
Viscosity, SUS at 210 F	63	60
Viscosity index	142	142
Free acidity, meq/g	Less than 0.01	Less than 0.01
Ash, per cent	Less than 0.01	Less than 0.01

Prior to the use of the synthetic lubricant in this machine considerable difficulty was experienced because of the large change in viscosity of the oil. Pumping difficulties were encountered with the excessively viscous oil at low temperatures, and full working pressure could not be maintained when the fluid thinned on heating. The high viscosity index of the synthetic gave more uniform flow. Packing leakage with the synthetic has been far less than with conventional oils. In this and other similar units the synthetic fluid has materially reduced maintenance costs.

Reduced wear is likely to be an advantage associated with the use of polyglycol fluids in vane and other pumps where boundary-lubrication conditions prevail. This can be seen from inspection of the results of laboratory tests summarized in Table 10.

TABLE 10 COMPARATIVE VANE-PUMP TESTS

	Results of vane-pump tests conducted for 750 hr at 1000 psi, 1200 rpm, 150 F fluid temperature		
	Petroleum hydraulic fluid	Phosphate ester-type hydraulic fluid	Polyalkylene-glycol-type fluid, LB-300-X
Wear loss of pump parts, g	0.91	1.05	0.05
Loss in volumetric efficiency, per cent	8	2	0
Initial fluid viscosity, SUS at 100 F	321	153	302
Viscosity increase, per cent	2.2	−4.6	1.0

In some hydraulic applications the use of a nonflammable or fire-resistant fluid is desirable. Should a line break or other leakage develop, the fluid is apt to be sprayed at high pressure and, if combustible, may spread a flame over a wide area (17). The Armed Forces have given this matter serious attention for military equipment. The U. S. Naval Laboratory developed an aqueous-base fluid, called Hydrolube U-4, which has been used in a number of Navy aircraft for several years (18, 19, 20).

Hydrolube compositions have been adapted for industrial use by suitable alteration in formulation and properties. For aircraft purposes a viscosity of approximately 85 SUS at 100 F is desired in order to avoid leakage and yet have adequate low-temperature fluidity. Hydrolubes of higher viscosity are usually required for industrial use and at present three other grades of approximately 200, 300, and 550 SUS viscosity at 100 F are available.

Hydrolubes consist essentially of the following:

1 Water for nonflammability.
2 Ethylene glycol as an antifreeze.
3 A high-viscosity water-soluble polyalkylene-glycol thickening agent to impart the desired viscosity.
4 Liquid-phase corrosion inhibitors.
5 Vapor-phase corrosion inhibitors.
6 Metal deactivators.
7 Antiwear agents.

Hydrolubes usually can be installed without changing seals, packing, or similar parts. Leakage is low in the average, properly maintained system.

Wear with the present industrial hydrolubes is generally comparable to that experienced with petroleum hydraulic oils. The loss of weight from the moving parts may be slightly higher, but this is counterbalanced by the excellent surface condition as reflected by little change in pump output. This is illustrated by the data in Table 11. Views of vanes and eccentric rings from 750-hr vane-pump tests on Hydrolube 300-N and a widely used petroleum hydraulic oil are presented in Figs. 5 and 6. The smoother wear pattern on both vanes and ring is believed responsible for the zero loss in volumetric efficiency with the Hydrolube fluid.

Hydrolubes have performed successfully in many industrial applications during the past few years, and have prevented

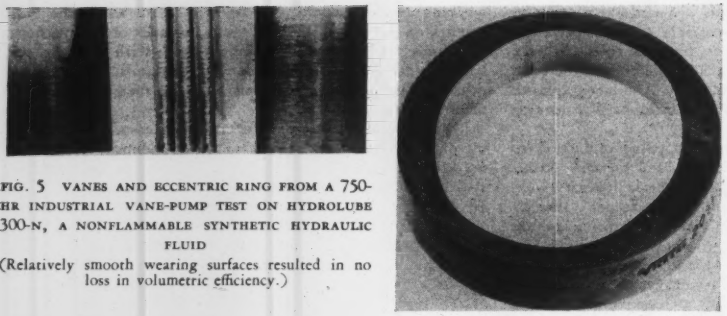

FIG. 5 VANES AND ECCENTRIC RING FROM A 750-HR INDUSTRIAL VANE-PUMP TEST ON HYDROLUBE 300-N, A NONFLAMMABLE SYNTHETIC HYDRAULIC FLUID

(Relatively smooth wearing surfaces resulted in no loss in volumetric efficiency.)

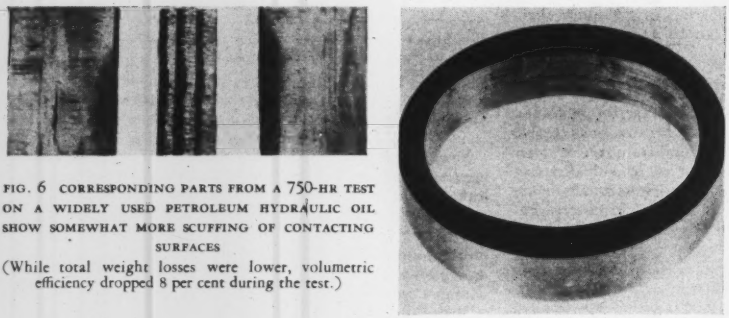

FIG. 6 CORRESPONDING PARTS FROM A 750-HR TEST ON A WIDELY USED PETROLEUM HYDRAULIC OIL SHOW SOMEWHAT MORE SCUFFING OF CONTACTING SURFACES

(While total weight losses were lower, volumetric efficiency dropped 8 per cent during the test.)

TABLE 11 INDUSTRIAL VANE-PUMP TESTS ON HYDROLUBE

	Results of vane-pump tests conducted for 750 hr at 1000 psi, 1200 rpm, and 150 F fluid temperature	
	Petroleum hydraulic oil	Hydrolube 300-N
Wear loss of pump parts, g	0.9	1.8
Loss in volumetric efficiency, per cent	8	0

injury to workers and damage to property in a number of instances. Hydrolube of the 550 grade has operated entirely satisfactorily for approximately 4 years in a manipulator handling hot steel parts in a railroad shop. The foreman in charge estimated that 5 or 6 fires were averted in the past year by the presence of hydrolube in this equipment. In a die-casting plant a line broke in a machine operated with Hydrolube 300-N. Two workmen were sprayed from head to foot with the fluid, which was also sprayed into nearby pots of molten metal. There was some steam generated, but no fire. A steel mill installed Hydrolube 300-N in a regulator. After more than a year of uneventful operation, 20 to 30 gal of this fluid were inadvertently pumped into a pit of molten slag without any serious consequences.

CONCLUSIONS

It has been shown that the special physical and chemical properties of the polyalkylene-glycol lubricants have proved advantageous in various types of industrial service. This presentation of some representative practical experiences may be helpful to mechanical and lubrication engineers confronted with similar problems. The development of new mechanical devices and the trend toward increasingly severe operating conditions will probably introduce new applications where the unique properties of these fluids will effect substantial savings in maintenance and the cost of lubrication.

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ENGINEERING *in* FOREST PROTECTION

By G. I. STEWART

SUPERVISOR, MICHIGAN FOREST FIRE EXPERIMENT STATION, MICHIGAN DEPARTMENT OF CONSERVATION, ROSCOMMON, MICH.

FOREST protection is concerned chiefly with control of forest fire, but to this must be added the influences of insects and fungi. These last two are natural factors little subject to human control; for the most part they are endemic, although catastrophies occur when epidemic conditions become established. Protection of timber resources from insects and fungi has become a highly specialized science of the entomologist and of the pathologist, while fire control has become an engineering problem.

Prior to 1925 most fires were fought by manual means, and, on occasion, great numbers of men were employed on the larger ones. In many sections of the nation this practice still prevails; it is determined largely by circumstances of population, accessibility of wilderness areas, facilities for transportation, character of terrain, types and character of forest fuels. However, throughout the nation as a whole, modern fire control is accomplished through mechanization of equipment. As rapidly as these techniques can be applied, manpower is being replaced by machines. Organizations maintained by leading states and the United States Forest Service employ skilled forces of modest numbers, and these are provided with modern apparatus of many kinds. As long as fire control was accomplished manually, it remained largely a problem of organization of manpower but the transition to machine equipment changes it rapidly into a complex field of engineering.

BENEFITS OF MECHANIZATION

Many benefits are derived through mechanization. In most instances prompt attack on forest fire decides the issue. Skilled officers are trained to make necessary decisions when fire locations are reached, within the shortest possible time, and to put into use proper machines capable of performing the work required. Increase in efficiency of machinery, as compared to manpower, is most noticeable in the amount of physical work that can be done within the first working hour. Motorized transport assures prompt arrival on location with necessary kinds and quantities of machinery. In so far as fire fighting itself is concerned, two major benefits result from mechanization: (1) Simplification of organization which permits fewer men to accomplish prompt and effective work; and (2) marked increase in work capacity and efficiency of individuals or groups.

In so far as management is concerned, benefits of mechanization are realized in many ways; perhaps the most important of these are budgetary inasmuch as funds expended on machines, rather than payroll, last far into the future and may be used repeatedly throughout their working life. Smaller and more efficient organizations can be maintained to accomplish more work in the field than would be the case if they employed manpower alone. Training programs are simplified, and these can be made more uniform for entire organizations of fire personnel. Due to these advantages, losses from forest fire in acreages and values have decreased greatly within the past decade. Moreover, it is certain that increases in effectiveness will continue into the future. It will be measured in terms of total areas burned in any given year and the average sizes of fires.

HOW FIRES ARE FOUGHT

Uncontrolled woods fire is a mobile thing. Its rate of spread is determined by many things, chief of which are moisture content of fuel, character and abundance of fuel, relative humidity, wind velocity, slope, air temperature, and exposure of fuel to drying influences. Theoretically, the area involved varies as the square of the time it has been burning. Owing to the fact that few fires spread equally in all directions, the actual rate of spread is somewhat less than this, and most fires assume elongated shapes determined by slope and wind influence. In periods of reduced hazard, rates of spread may be moderate and fires easily controlled; but when fuel is extremely dry as in spring periods, and when weather conditions are hazardous, rates of spread may be as high as a mile in five minutes. For short periods of time even faster rates of spread have been recorded.

In controlling running fire the immediate problem consists of stopping the moving perimeter, especially the head which moves at the fastest rate. Because of the behavior of fire, its movement in occupying land area has been compared to the action of military forces in battle, and the tactics employed to stop it are similar to those of a defending force. Men and equipment are moved in; positions are taken and maintained, and every effort is made to use all favorable circumstances of natural barriers and terrain. In its movement, fire spreads through continuous fuel, and in stopping it every bit of flame along the moving edges must be extinguished. The amount of physical work required is enormous, especially since the time element is so important.

Effective methods can be made relatively simple if machinery is employed, and usually consist of constructing fire lines or barriers as close to burning edges as possible; or by subduing burning fuel with water. Many combinations of methods are useful, but for the most part, barriers must be built with heavy plows or other dirt-turning equipment, or fire must be stopped with tanker units and powerful pressure pumps. The difficulties lie not in method, but in the development and manufacture of suitable machinery capable of performing effective work under woods conditions. It is an engineering problem throughout.

MECHANIZATION IN FOREST-FIRE CONTROL

It is self-evident that mechanization in forest-fire control attempts to apply machine methods to all work phases involved. The problem is far more complicated than it would appear because most of the equipment required exists on the open market only in limited types and quantities. Furthermore, forest conditions vary greatly throughout the nation,

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and many kinds of equipment find only regional or local application. If types of machines remain more or less uniform, necessary differences in sizes still add to the complexity of the problem. Consequently, markets for such equipment are limited, which discourages commercial production. Most conservation agencies through sheer necessity have been compelled to invent, develop, and actually manufacture many classes of machines suitable for woods work.

At the present time, modern organizations own equipment in fleets that are dispersed throughout protection areas to the greatest strategical advantage. Such equipment falls into two general classifications, namely, (1) transportation equipment; (2) suppression equipment that performs the actual fire fighting. Considerable numbers of standard units are procured commercially. Specialized items that must be fitted to particular woods conditions require development from initial stages of design and invention to final production in quantity.

Transportation facilities consist of trucks in various sizes, semitrailer units, four-wheel-drive vehicles, pickups, cargo trailers, and cars. Fleets of these vehicles guarantee transportation for heavy fire-fighting apparatus and for personnel. Aircraft is in common use.

Suppression equipment involves a wide variety of machines, and in any one region or locality, woods conditions determine its composition. In general, it consists of tractors and bulldozers, heavy plows, graders, line builders, trenchers, and other classes of dirt-turning machinery, power pumps in many sizes, tanker trucks, trailers, including tanker units, well-sinking and well-pumping outfits, and varieties of specialized items. The distinguishing feature about it is lack of conformity to standard kinds of apparatus. Every suppression machine must be capable of operating in the woods, under severe conditions, and off the road; otherwise its usefulness is limited. All suppression machinery must incorporate features of design and construction which assure its assignment to woods operation. Much of it has been manufactured by conservation agencies in small shops with inadequate attention to correct engineering design. However, this was a stage of growth as mechanization was being developed. For a number of years experiment stations and research centers have been operated by some of the states and the Forest Service. Their efforts are devoted chiefly to equipment development and to its final manufacture.

APPLICATION OF ENGINEERING TECHNIQUES TO EQUIPMENT DEVELOPMENT

Throughout the nation programs are undertaken in various ways, but the methods employed by the Michigan Department of Conservation will exemplify application of engineering skills to the problems involved. Since 1930, the Michigan Forest Fire Experiment Station has been operated as a research center, and equipment development has been accorded first priority among all projects. The station has applied engineering methods for many years, and the results have been beneficial throughout the nation. Because of the magnitude of problems of mechanization, it is doubtful if results could be obtained efficiently and economically in any other way. The perfection of successful models of plowing machinery and subsequent manufacture might serve as an example of the ways in which all apparatus is developed and produced by the Experiment Station.

Analysis of Field Requirements—Plowing Machinery. Forest types—hence fuel types—vary greatly and woods conditions require full analysis before machine equipment can be adapted successfully to them. This is especially true of plowing units, which are used as line builders. It is their function to construct plowed barriers, free of all inflammable materials, where the moving edges of fire ultimately will be stopped. It is doubtful if any other class of machinery is expected to operate under more difficult circumstances, or to sustain more abuse. Machines must be designed to operate throughout a wide range of conditions, to embody adequate structural strength without excessive weight, and to assure the highest degree of mobility. Because of these requirements successful fire-control plows bear little resemblance to agricultural implements. Conditions under which plows are intended to function might be listed as follows for many millions of acres of forest land:

(*a*) Due to continued fire protection and normal growth, the density and size of timber restrict vehicular travel to crawler tractors. Plows suitable for line-building must be adaptable to crawler tractors as draft machines. Most areas are characterized by mineral soil, often rocky.

(*b*) Roughness and steepness of terrain can be negotiated only by crawler tractors.

(*c*) Swamp lands intermingle with upland types and present conditions that limit vehicular operation to crawler tractors. Soils involved are usually muck or peat.

(*d*) Tough turf and heavy root mats characterize the kinds of ground conditions to be handled. Plowing depths range from a few inches in mineral soil, to 16 in. in root mats and in muck soils. To hold plow slices, total width of line should range from 5 to 7 ft.

(*e*) Ground cover will range from grass to heavy accumulations of shrubs and brush. In adapting plows to these conditions, it is imperative that maximum clearance be provided for in design, so that debris will move freely with the furrow slice and avoid clogging within the plow structure. Windfallen timber will be encountered frequently.

(*f*) Timber will range in density from fairly open stands to dense plantations, or natural growth of similar-size classes. Diameters will range up to 24 in. with the majority of trees falling in size classes under 12 in. Some stands will number 1500 trees per acre. To guarantee passage between trees, total width of plow should not exceed width of crawler tractor.

(*g*) Mineral soils will vary from sand to heavy clay. Rocks, boulders, heavy roots, and stumps will have to be handled by the plow. Total clearance in the plow base and other functional parts must be sufficient for the bottoms to uproot and turn under all trees which the tractor might ride down.

Tentative Plow Specifications as Determined by Analysis of Woods Conditions. In performing the functions of line-building under circumstances listed, a successful plow would be expected to handle all of the soils encountered and to plow out of the line all trees and brush that might be ridden down by the draft tractor. The design of such an outfit is a detailed job in engineering. If undertaken with no previous experience in machine design, a number of experimental outfits would have to be produced before a satisfactory implement would evolve. At best, much research is needed and extensive field testing carried out before requirements would be met. Decision on tentative specifications must be made and might be arranged as follows:

(*a*) In so far as possible commercial materials will be used in order to guarantee access to parts, and to avoid shop manufacture of special items.

(*b*) Minimum acceptable width of line averages 5 to 7 ft. Allowing for turned plow slices, this is best attained by use of a double-bottomed plow (reversed bottoms) with slices being thrown both ways from the center of the bases.

Plow bottoms of commercial make will be used. Right and left-hand bases will assure reversed slices of required width. They should be classed as 18-in. bases, since a total of 72 in. of bare dirt would be exposed.

In order to handle all of the types of soils listed, the mold boards are to be high and long. Selection of proper plow bases is the most important single factor of design.

(*c*) Severity of ground conditions as indicated by rocks, heavy turf, root mats, heavy soils, and stumps, require the use of stout and durable coulters. Need for two coulters is indicated; one of these mounted inde-

pendent of the plow base will be a disk or rolling coulter; minimum diameter, 30 in.

(*d*) Inasmuch as reversed bottoms are to be used, good design will permit setting them against a middle coulter. This middle coulter will be designed in several shapes of cutting edges; final shapes selected for use will permit adapting best forms to local conditions. Body of the coulter will be plate steel. Cutting edges will be formed by alloy bar, shaped and welded to the plate section. Final cutting edges will be made extremely sharp and hard, heat-treated if necessary.

(*e*) Due to large amounts of surface debris and ground trash, that must be handled, ample clearance will be provided beneath the plow beam. A final height of 33 in. to top of beam will balance well with the size of rolling coulter selected.

Experience in line building with plows requires a beam length that will maintain a favorable ratio secured at the drawbar as compared to the height of beam. Total beam length of 8 ft is needed which will allow space for attaching all parts of the bases including braces, all parts of the drawbar, the headplate, and proper proportion of the standard.

(*f*) Due to preferred use of crawler tractors, drawbar capacities as high as 10,000 lb must be provided for, although normal draft should not exceed 6000 lb.

(*g*) With draft capacities known from Nebraska tests, stress calculations will determine final sizes, sections, and details of fabrication of all parts making up the final machine

With the foregoing tentative specifications decided upon, features of design are completed on the drawing board.

Perfection of Pilot Model. When all stages of assembly are completed in plan, individual parts are detailed and precisely specified. Many of these must be made as castings, in steel, and malleable iron; patterns are developed for cast parts as required. Other parts are forged, turned, milled, or otherwise fabricated from solid stock, rolled sections, or tubing. As this process is carried out at the Experiment Station, manufacture of all parts and assembly of the entire plow are completed in its own shops. The final plow as developed by engineering analysis is illustrated in Fig. 1. Actually, this particular machine is the third model that has evolved in the manner explained. Improvements in design and construction followed assignment of machines in actual fire fighting. This type of plow has been in use in Michigan since 1936. Major dependence has been placed upon it for forest-fire control, and it is standard issue with the Michigan Department of Conservation. Eighty of these machines are in use at the present time.

Production in Quantity. After a machine of the type described proves acceptable to an organization, procurement in required number presents a problem, and this is likewise true of all other classes of machinery. Owing to limited markets, manufacturers are seldom interested in furnishing the modest numbers required at any one time. Because of this, manufacture is carried out in station shops. Manufacturing steps are similar to those in commercial plants. When finished, the units are retained for public use by the State of Michigan, or other agencies engaged in forest-fire control, but they are not sold as commercial items.

FIG. 1 MICHIGAN DOUBLE-BOTTOMED SULKY PLOW

(Plow ready for line building. The trailer-hitch attachment has been removed and machine is ready to couple to drawbar of tractor. Full-floating carriage is shown, and winch control.)

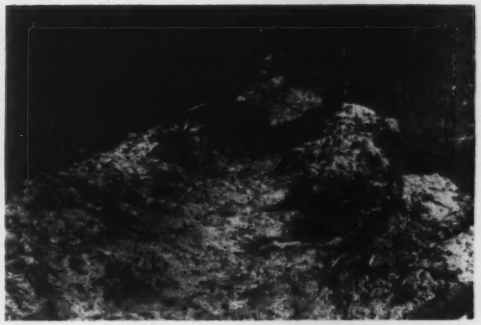

FIG. 2 TYPE OF FIRE LINE CONSTRUCTED BY DOUBLE-BOTTOMED SULKY PLOW

(This barrier is typical of the kind of line used to control forest fire. It averages 7 ft in width. With proper organization of a ground crew severe fires can be stopped by such a fire line.)

Mass-production methods are put into effect. Jigs, fixtures, templates, patterns, gages, welding positioners, and other necessary items are provided to govern production of all parts. Assembly lines are set up, and all phases of manufacture are completed. Each machine is finally identified by a metal plate listing model number, serial number, and unit number. Upon completion all machines are assigned to headquarters, or equipment depots to fulfill their purposes in fire control. During manufacture complete sets of prints and fixtures maintain adherence to specifications.

As a final step in issue, detailed instruction booklets are distributed and training periods are held with operators, to guarantee their familiarity with machines. This is especially necessary when improvements or model changes have been made.

CONTINUATION OF WORK IN FIELD TESTING AND MACHINE ANALYSIS

After pilot models are finished, or manufacturing schedules completed, further analyses from an engineering standpoint are desirable. These analyses are best made under field conditions similar to those under which equipment will be used.

It is essential, for instance, that data be assembled to determine draft requirements of plows in question, in terms of drawbar pull. Figures resulting from field measurements are reduced to graph records and tables. Results of field testing may be used to predict or check the adequacy of crawler tractors in terms of operating speeds and capacity, as compared to the drawbar requirements of the plows to be used with them.

In actual line building, operating speed is extremely important. If for some reason, a preferred type or model of tractor were overloaded, measured ratings of performance and drawbar requirements would indicate the fact; further work on plow design for purposes of assuring lighter draft might be required to match the machines properly. This would continue to be an engineering problem and lend itself to systematic analysis.

FIG. 3 TYPICAL TRACTOR-PLOW UNIT USED IN FOREST-FIRE CONTROL

(Michigan double-bottomed sulky plow, attached to tractor in line building.)

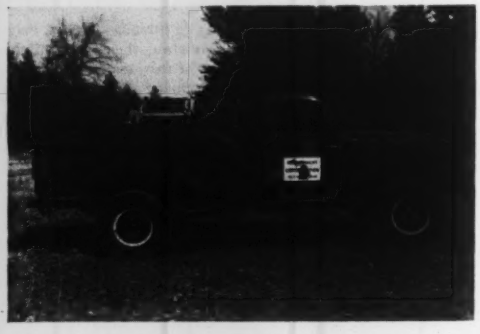

FIG. 4 POWER WAGON CONVERTED TO TANKER UNIT

(This is a four-wheel-drive vehicle well adapted to woods travel. Body is completely armored. It is outfitted with a high-pressure pump, driven by power take-off, ejector tank refiller, live reel, complete tool equipment and two-way radio-communication system. A kit of hand tools is included also.)

FIG. 5 STANDARD CRAWLER TRACTOR EQUIPPED AS A FIRE-FIGHTING MACHINE

(Used with heavy plows in constructing fire line. Commercial model of tractor has been converted to tanker unit by addition of water tanks and power pump, driven by a front power take-off.)

SCOPE OF EQUIPMENT DEVELOPMENT

In the foregoing the evolution of only one class of machine was discussed. The same procedure applies to any other kind of equipment. In so far as the Michigan Department of Conservation is concerned, more than half of the outfits used in forest-fire control have been developed at the Experiment Station, and manufactured in its own shops. Fortunately, most motorized equipment can be used as standard commercial products; necessary conversions are usually simple. Tractors in large numbers and in several sizes are used as bulldozers and draft machines. Conversions are frequently made even on such basic machines as these in order to adapt them better to woods work or to increase their usefulness.

Outfits which have been developed and built in quantity are as follows:

1 Well-sinking and well-pumping units. Used for sinking shallow wells and pumping from them. Time required to place shallow wells into operation seldom exceeds 1 hr.

2 Breaker plows; walking types; used for rough operation in rocks and dense timber. Single-bottom plows.

3 Semitrailer units for heavy transport duty.

4 Trailer-mounted pumping equipment; heavy duty; used for long periods of operation on slash fires and burning muck; swamp fires. Used often in conjunction with well pumping.

5 Cargo trailers of a number of models. Used for general cargo duty in transporting fire equipment and supplies.

6 Fire cache trailers; Designed especially to store and carry hand equipment; also to carry portable pumping equipment and all accessories.

7 Michigan line builder; Seven models in all. Designed as an intermediate machine for building barrier on lighter soils. Intended to be used as a small tractor, and capable of line-building at moderate speeds; assigned to small crews.

8 Tilt-bed trailers for general transport; especially with tractors and line builders.

9 Tanker trucks; especially designed around four-wheel-drive units. The power wagon, shown in Fig. 4, is an example of this development, when converted to a tanker, and equipped with high-pressure pump, two-way radio, full accessory equipment, body completely armored.

10 Sulky plows in several models; mounted on pneumatic tires. Capable of line building under the severest woods conditions, and over a wide range of soil types. Adapted for use with many sizes of tractors. Suitable for fast fleet movement.

11 Michigan tractor-tanker; a conversion of standard crawler tractors in 30-hp class (Fig. 5), to incorporate water tanks carried on the tractor, to furnish water supplies to power pump mounted on the tractor and driven by power take-off. Equipped with special features such as live reel, armored bumper, and accessory equipment.

This machine is built in a second model in which the pump is self-contained and operated by independent gas engine. Both models are adapted to line plowing, or to selective use with tanker trailers, which permits them to be used mainly as line builders, or as full mobile water-using outfits. Frequently used in team organization with the power-wagon tanker.

PRESENT-DAY FOREST CONDITIONS

The scope of equipment development is almost unlimited. At the present time much of the woodland of the United States is restocking a heavy second growth of timber, and forest conditions are changing rapidly. Density and size of timber stands are increasing, due to continued fire protection. It is likely that extensive and free operation of crawler tractors will be much restricted with the passing years, and that other kinds of machines will find their place as line builders. Major dependence will probably continue to be placed upon dirt-turning machinery, but it is to be expected that kinds of apparatus not yet perfected will be employed. Even though organizational planning has been well worked out, new types of equipment will modify present procedures. The uses of chemi-

(*Continued on page 495*)

New TASKS *in* ENGINEERING *for* SMALL PLANTS

By FRANK W. MILLER

VICE-PRESIDENT MANUFACTURING, YARNALL-WARING COMPANY, PHILADELPHIA, PA. MEMBER ASME

MOST small plants require engineering work in various forms through either the full-time or part-time employment of engineers, or both. Part-time employment includes the use of commercial laboratories, university engineering departments, and consultants. These engineers solve problems assigned to them or created by them. In either case the solutions are fundamental to the progress of the company.

Other lines of engineering which are needed and are becoming most helpful include machine manufacturers, process-apparatus builders, instrument firms; equipment manufacturers of cranes, hoists, conveyers of many types, fire-extinguishing apparatus, lighting fixtures, and the like; and architectural and construction firms which provide small-plant designs, specially designed floors, walls, and heating and ventilating installations.

Engineering by and for the small plants has grown appreciably. It is bound to grow into much greater proportions as small-plant managers aim to improve their plants to keep competitive. Material costs, wages, and taxes will go still higher, and engineering will be called upon to offset these new costs. Machinery and equipment firms should increase their supply to the small-plant market with more specially designed products.

For example, control, recording, and indicating instruments have been developed for guiding many processes in chemical plants, operations in mechanical handling, and sequence of operations in manufacturing. Small and large plants have recognized the growing need for these instruments and are now making numerous types. They are definitely applicable for use in small plants, and small-plant management should recognize the accuracy and economy of such units to replace older instruments and methods.

ELIMINATE OBSOLETE MACHINE TOOLS

One new engineering task for the small plant is to eliminate obsolete machine tools. The machine tool which can perform automatically the required operations consistent with quantity of parts involved and difficulty of machining operation is the most economical to use. The machine tool requiring the least expenditure of human energy should be recommended and carefully selected by an experienced engineer. Human energy costs about $1.50 per hr whereas electric energy in like quantity costs 0.1 or less cent per hour—a ratio of 1500 to 1.

The machine-tool builders have done much for the small plant, but there is much more to be done. More flexible machines for shorter runs, and simpler, less costly machines are needed. For example, the modern horizontal boring mill is an expensive machine, suitable for many uses. When such a basic machine is needed for a few simple operations in the small plant, it is found economically unavailable. The many small plants needing special machine tools should awaken the interest of machine-tool builders. The market would seem to justify an active seeking to satisfy their needs.

Contributed by the Management Division and presented at the Annual Meeting, New York, N. Y., November 26-December 1, 1950, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS. (Condensed.)

TRANSPORTATION ENGINEERING

There is a reluctance to correct such important necessary items as sufficient floor space and adequate internal transportation. With greater floor area available, machine tools can be placed according to the most economical plan. An engineer acquainted with the flow of materials can lay out efficient floor plans carefully. Machines can be placed strategically to avoid wasted steps in getting material to and from a machine and provide for the shortest distance to the finished stores, inspection department, toolroom, shipping department, and so forth.

A saving of 35 per cent of the handling cost was made possible in a machine shop by providing modern facilities such as electric hoists, motorized trucks, hydraulic lifts, and accessible bins of sufficient size and area for placing rough and finished work at machines.

An addition to plant of 28 per cent in manufacturing and stores floor area in 1948, provided for rearrangement of machine tools and relocation of some departments. The savings in travel distance of some valve parts was some 8785 ft, or 63.7 per cent.

Fig. 1 shows travel distance and flow line of a valve gland before rearrangement.

Fig. 2 illustrates the saving of 480 ft, or 75 per cent, in travel distance of this same part after rearrangement.

The return on investments made to obtain these savings is a reward for engaging engineers to solve such tasks.

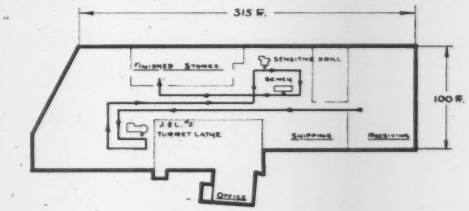

FIG. 1 TRAVEL DISTANCE AND FLOW LINE OF VALVE GLAND BEFORE REARRANGEMENT—635 FT

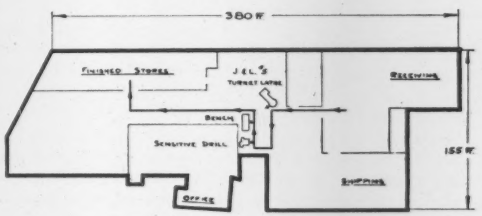

FIG. 2 TRAVEL DISTANCE OF GLAND AFTER REARRANGEMENT, 155 FT—A SAVING OF 480 FT

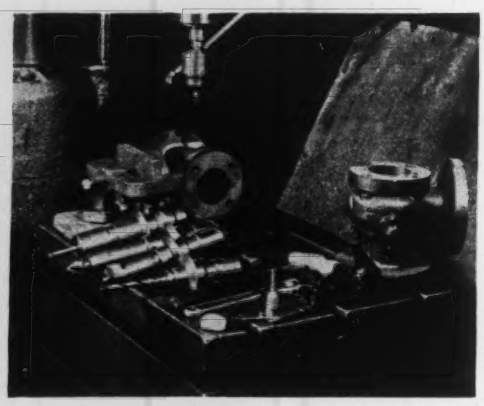

FIG. 3 DRILLING AND TAPPING A $1^1/_2$-IN. STEEL VALVE BODY FOR GLAND STOP SCREW ON AN UPRIGHT DRILL RESULTED IN A RATE OF 12 BODIES PER HR

The cost of handling material in this plant was about 10 per cent of the shipping dollar. This is a large part of that important dollar. Unavailable material, resulting from crowding, causes the material handler to move the material wanted as much as three times. Lack of trucks, tote pans, dollies, bins, and skids resulted in paying for man-hours not gainfully employed.

Transportation and layout are important engineering tasks to be studied by engineers and then remedied. The improvement may be a simple rearrangement of facilities or, when growth in past and future are to be provided for, it may be necessary to go to the extent of an addition of floor space; and the savings will justify the investment.

TOOL ENGINEERING

Carbide cutting tools are still restricted in many small plants. But they can be used successfully on almost all work, including interrupted cuts. For example, a carbide cutting tool may replace grinding in finishing valve seats and disks having Stellite facings. Improved cutting tools have come into large-scale use during and since World War II. They have been accepted so rapidly that they have acted as their own key to an improved rate of cutting metals. A trained operator with technical ability is required properly to prepare these tools and demonstrate the most effective use of them, but, when properly prepared, such tools effect savings not only in tool material but in machining the part, and this more than offsets the higher cost of the more highly skilled man.

Tipping tools with carbide and grinding tools in a department having suitable grinders for such work can save 50 per cent or more of cutting-tool costs.

Specifying correct drills for special work, such as drilling Stellite, can solve difficult operations.

In the author's plant, drilling and finishing small-radius entrance holes, less than $^1/_{32}$ in. in diam in stainless steel were costly in time lost and broken drills, until an engineer was assigned to study the problem. The study resulted in a cost reduction of 35 per cent. Since these finished stainless-steel parts are made in lots of 5000, savings are appreciable and continuous.

METHODS ENGINEERING

A good shop-methods engineer can be the engineering key to real savings by creating easier working conditions and faster operating cycles. Any machine-tool operator, given the proper machine tool of the latest type and having his machine equipped with correct cutting tools, is still in need of jigs and fixtures and a practical norm for feeds and speeds.

Feeds and speeds, as well as the material being machined, determine the life of tools and the effective cutting rate, and to a large extent the conditions of the finished piece. The heavy modern machine tools with large motors and with properly prepared tools can produce quality work in much less time than previously required.

Some examples of cost-saving machining and assembly operations are shown in Figs. 3 to 8.

Fig. 3 shows a $1^1/_2$-in. steel valve body being drilled and tapped for a gland stop screw on an upright drill. The production rate was 12 bodies per hr.

A well-designed drill jig, Fig. 4, when used on the same upright drill, increases production to 23 bodies per hr (or 91 per cent increase) with a marked improvement in quality.

The packing channel of an expansion-joint gland is shown in

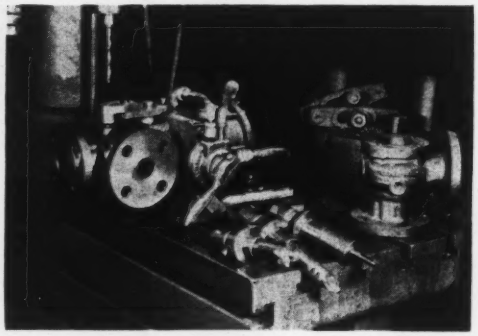

FIG. 4 NEWLY DESIGNED DRILL JIG USED IN SAME UPRIGHT DRILL AS IN FIG. 3, INCREASED PRODUCTION RATE OF STEEL VALVE BODIES TO 23 PER HR

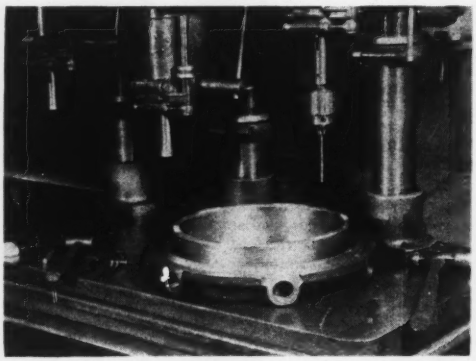

FIG. 5 EXPANSION-JOINT GLAND IN POSITION FOR DRILLING PACKING CHANNEL BY OLD METHOD—PRODUCTION RATE 0.77 GLAND PER HR

position for drilling under a small upright drill in Fig. 5. By using the old layout method, the overlapping twin holes required for the elongated opening, including drifting-out of metal between holes, was completed at the rate of 0.77 gland per hr (for 10-in-size expansion joint).

Fig. 6 shows a new indexing and drilling fixture, together with the knockout unit to produce the same elongated opening. The rate of finishing was increased to 1.49 per hr, or 93 per cent.

A $^1/_2$-in. cast-iron strainer assembly, Fig. 7, was made by holding the body in an ordinary vise and inserting the internal parts. This was followed by tightening the screen bushing with a box wrench. Production rate was 25 assemblies per hr.

The parts were rearranged conveniently in subassembly and final assembly as shown in Fig. 8. Also shown in Fig. 8 is an air-operated vise controlled by foot valve to hold the bodies while subassemblies are put in place and tightened with an air-operated wrench. The equipment investment and convenience of parts arrangement increased the assembly rate to 139 per hr, or 450 per cent.

These examples show the savings made possible by an engineer alert to the possibilities of changing and improving jigs, fixtures, and assembly conditions in a small plant.

MATERIAL ENGINEERING

Each manufacturer purchases raw materials. As new and improved products are developed, it becomes essential for company engineers to select materials best suited for the product, for the producer in terms of costs and production time, and for the product user. A company cannot avoid this because the advances are often so great that a competitor, by using them promptly, can secure a distinct advantage. To evaluate the extent to which the new or improved products can be used is a continuing task of the engineers. One of the materials used by the author's company is Nitralloy which has been accepted as a good plunger material for our seatless valves. It lengthens the life of these seating surfaces and makes economically possible the valve control of fluids at relatively high temperatures and pressures.

Ductile titanium is one of the newest engineering materials. It has desirable characteristics such as great corrosion resistance. The cost is high at present, but the cost of aluminum also was high at one time.

The host of new materials presented to the manufacturer is large in number and field of usefulness. Selecting the right material is "operation engineering" and competitively a necessity. It is fortunate that we have so many materials. This is one of America's greatest assets and avoids depleting a strategic material without having a substitute. In fact, the lay opinion has developed in this matter to such an extent that, when some natural resource is in danger of depletion, it is fully expected that the engineers and scientists will provide a better one.

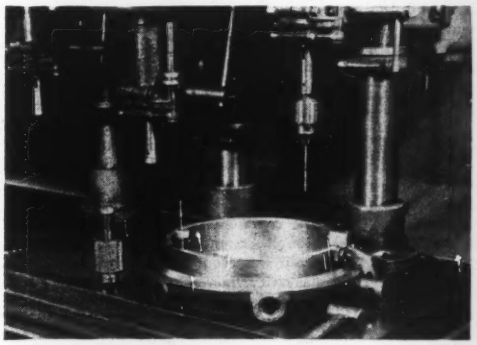

FIG. 6 NEW INDEXING AND DRILLING FIXTURE, INCLUDING KNOCKOUT UNIT, RESULTED IN PRODUCTION INCREASE OF GLANDS TO 1.49 PER HR, OR 93 PER CENT

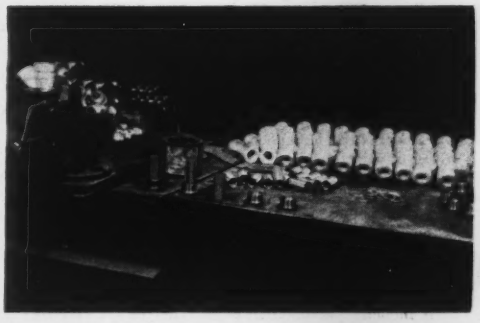

FIG. 7 OLD METHOD OF ASSEMBLING $^1/_2$-IN. CAST-IRON STRAINERS SHOWING POOR ARRANGEMENT OF PARTS—PRODUCTION RATE 25 ASSEMBLIES PER HR

FIG. 8 REARRANGEMENT OF PARTS AND ADDITION OF AIR-OPERATED VISE INCREASED ASSEMBLY RATE OF STRAINERS TO 139 PER HR, OR 450 PER CENT

ENGINEERING SPECIFICATIONS

Back of the engineering specification there is a designer who has carefully prepared the symmetry of design, materials to be used, and exactly how each step in preparation of finished part or process is done. In his hands lies a large part of the cost of the completed product. In some plants this varies from 25 to 35 per cent. Yet in almost all small plants there is a lack of the fundamentals of cost studies of the product's component parts and the finished assembly. Usually a good guess suffices for the answer to the materials specified and the shop methods required for production.

This haphazard control of such a large part of product cost can be corrected by engaging a trained engineer with a desire to consult cost and production departments in meeting a predetermined competitive price. This can be done without sacri-

(*Continued on page 499*)

The ENGINEER—*How He May Widen His Avenues in* PUBLIC SERVICE

By FRANK H. NEELY

EXECUTIVE VICE-PRESIDENT, RICH'S, INC., ATLANTA, GA. MEMBER ASME

CIVICS embraces much more than a study of or a dissertation on structures and functions, or a general interpretation of the laws applying to these.

(1) It includes public-mindedness; (2) the creation of the right attitudes toward public duties; (3) the formation of the habits of helpful, constructive, participating citizenship; (4) the development of activities which result in effective participation in good government; (5) the consideration and application of procedures and processes which will result in the greatest good for the greatest number in all social units, big or little."

Governed by Mr. Wright's abiding belief in, and consecrated practice of, "civics" as thus defined in the Encyclopaedia Britannica, the Council of The American Society of Mechanical Engineers established the Roy V. Wright Lecture in 1949.

An enlargement and analysis of such definition as applied to the engineer, only too prone to limit his development to his own field, may be in order as we honor this public-spirited man, and endeavor to further his ideals of citizenship.

Too rarely in our day-by-day life do we pause to consider that, as Americans, we are unequaled in our privileges and personal freedoms.

In a recent article (March, 1951, issue of the *Atlantic Monthly*) Mr. Bertrand Russell writes:

". . . . In America, if you are a geneticist, you may hold whatever view of Mendelism the evidence makes you regard as the most probable; in Russia, if you are a geneticist who disagrees with Lysenko, you are liable to disappear mysteriously. In America, you may write a book debunking Lincoln if you feel so disposed; in Russia, if you should write a book debunking Lenin, it would not be published and you would be liquidated. If you are an American economist, you may hold, or not hold, that America is heading for a slump; in Russia, no economist dare question that an American slump is imminent. In America, if you are a professor of philosophy, you may be an idealist, a materialist, a pragmatist, a logical positivist. . . . In Russia, if you fail to follow the developments of official metaphysics with sufficient nimbleness, it will be the worse for you! Stalin at all times knows the truth about metaphysics, but you must not suppose that the truth this year is the same as it was last year. . . ."

This contrast of the liberties and personal freedoms embodied in America, as opposed to those in Russia, comes after Mr. Russell has posed two other alternatives of destruction, with the resulting decision that democracy must overpower other forms of government and control the world through benign but strong forces. Of all eventualities the only hope rests upon the philosophy of freedom and the participation in government now practiced only in the principles of democracy as exemplified by the United States of America.

The Roy V. Wright Lecture presented at the Spring Meeting, Atlanta, Ga., April 2-5, 1951, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

1 What, then, are these privileges?
2 Where do they begin?
3 How may they be developed?
4 How implemented?
5 And finally, how may the engineer participate, assume leadership, and inculcate these principles that may mean the ultimate survival of our world?

The engineer must ask himself these questions, must suit his talents to the occasion of understanding man and the desire of serving his needs.

A citizen is a member of a state, a person native or naturalized, who owes allegiance to a government, and is entitled to the protection from it. To be worthy of freedom inherent in our democracy, we must on our part accept the duties and responsibilities demanded of us as citizens.

Whenever there is a crisis in the government, or if the government be threatened from an outside source, automatically patriotism swells up in us, we eagerly offer property, life, lives of our children, in meeting the demands of such citizenship When the life of a democracy is at stake we act to any limit; nothing counts but the protection of our country.

However, the minute the danger is over we cry for "our boys to come home;" we fall into the usual lethargy prevalent in peacetime; we say the government can run itself; we fail to exercise our citizenship in any endeavor, we even "don't trouble" to vote. In time of war our allegiance needs no encouragement, the emotions fan courage and sacrifice; but when that necessity passes, when immediate emergency declines, when danger is over, we take our government for granted; we do not concern ourselves with its functions; and we lapse into *civic inactivity*.

I, therefore, take it that the Roy Wright Lecture was intended by the Council of the ASME to encourage practices in citizenship in everyday life; to stimulate interest in government in any avenues that may open themselves for contribution and participation. Citizenship, as we shall continue to discuss it, means unselfish devotion in a small or large manner, in service of the community, the state, or the nation. Call it sacrifice, if you will. For the engineer it takes two main forms. The sacrifice growing out of making a career of public service. In this area the engineer deliberately chooses a career which employs his talents and abilities. In such government activity the financial personal advancement is more or less limited by the type of work itself, it is circumscribed by the particular service to the community. There are hundreds of such jobs now held by engineers under constituted governmental authorities. These are "career jobs"; they must be appreciated and interpreted as *civic activities*.

But the second type of citizenship to which we hope to point the way, and to glorify by the privilege of the Roy Wright Lecture, is, for the want of a better term, what we shall call "Public Service." By this term we indicate that the engineer is rendering to the public, over and above the "call of duty," and above his normal business concerns, some contribution to civic life.

This intelligent service is compensating only in the satisfaction to the engineer that he has lent himself in some small way to the betterment of his community, where his special talents, either technical or organizational, are required.

The opportunity to serve is available to the engineer in all of our various political subdivisions: the city, the county, the state, the nation. In approaching the problem from this point of view, it is immediately evident that the engineer must know the mechanism of government in the division in which he decides to serve, the interrelationship of the various divisions, and the part played by the duly elected officers responsible for the units they represent. Many times he will be shocked by apparent incompetency and inadequacy among those officials; but *his* will be the task to understand these constituted authorities. They exist, and are in actual control of the government. The more incompetent these officials, the more help they will need from thoughtful, straight-thinking, analytical, honest men. The engineer equipped with these qualities can be of incalculable benefit.

It is a notable weakness that men of professions and leaders in business and industry fail to develop the language and understanding of and sympathy with men whom they have voted into office. They are loath to discuss with them the problems relating to their offices, and make no endeavor to influence them for the good of the community. You may be sure that less worthy individuals are constantly on the alert to influence these elected leaders in behalf of their own personal interests, no matter how detrimental their plans may be to the interest and even the morals of the community as a whole.

Having determined to lend aid and interest by whatever means possible in any of the foregoing political divisions—the city, county, state, or nation—the engineer then asks the question, "What can I do? How can I fit in?"

Now, if you show interest in the affairs of your community and its problems, and tolerance and sympathy for the officials who are trying to serve to the best of their abilities, you will be sought for the many and various boards and committees subsidiary to the parliamentary setup, but necessary for its highest productiveness.

The activities in which the engineer's mind may find a fertile field may be classified under three important headings, that of (1) education, (2) technical services and advice, and (3) social services.

EDUCATION

Education, the primary concern of us all, offers to the engineer a range of service from active membership in a Parent-Teacher's Association, where his child is receiving his primary education, to membership in the Board of Regents, the control committee of higher education in most states. It includes in its spread membership in city, county, and state boards of education; it may take expression in the service of alumni associations and foundations; it may well be a part in the governing board of private, denominational, or religious schools, which, too, need men of vision and analytical ability to help in the solution of their multitude of problems.

Problems in the categories of education that require knowledge and wisdom and imagination include the physical surroundings, geography, and equipment of the school; the personnel of its teaching staff; its curricula; the co-ordination of the units with private and public controls, as well as the co-ordination with local branches of schools, higher or lower; and ultimately with colleges in other parts of the country . . . . all of these ought to be intriguing to the engineer. For faithful to his training, *with uncluttered mind*, he ought to be able to go straight to the heart of the matter under discussion, clarify situations, and arrive at the shortest and best manner of solution as suggested by the facts in hand.

TECHNICAL SERVICES AND ADVICE

As the rapid growth of the cities and problems of transportation of men and materials in congested areas become more evident, and as the sanitary, water, and other public-service problems need thoughtful approach in their complicated departments, there have come into being, as a crutch to governmental agencies, various boards which purport to study, advise, and plan as adjuncts to the committees formed from the political group. These boards of laymen comprise, for instance, Housing Authority or Slum Clearance Committees; Metropolitan Planning Committees; Zoning Committees; Traffic and Parking Study groups; special Bond Commissions assisting in the passage of and expenditure of governmental funds for special technical and structural purposes; and numerous other boards and commissions upon which the elected body may lean for authoritative support.

Trained in these purely technical matters of planning, and of movement of men and materials, the engineer on these volunteer committees may be of untold assistance to the authorities and professional men on the jobs.

SOCIAL SERVICES

In speaking of how the engineer may fit in the Social Services, we may well recall that during the depression of the nineteen-thirties, when human suffering was more than immediate communities could alleviate, emergency-relief groups were formed, and public assistance, i.e., social security, unemployment insurance, aid to dependent children, and so on, followed as a national measure. This was tax moneys distributed to the various states and their subdivisions. While this is known to you all, it will bear reviewing as a part of the picture into which the engineer may fit in the social services.

These public-welfare activities growing out of the change in social structure give opportunity to the engineer on boards where sane unprejudiced advice is invited; for the boards of these agencies are made up of citizens who are responsible for the general administration of the public funds, that is, allocations by the States supplemented by the Federal government. The Federal funds alone for 1952, in the public assistance to the aged, disabled persons, and dependent children, for public health and other activities, and for crime control and correction, amount to two billion dollars.

In addition to the public assistance, there remain many private charitable and philanthropic ventures, with attendant civilian boards, such as the YWCA, the YMCA, the Community Chest Agencies which embrace also the Boy and Girl Scouts, Campfire Girls, and other recreational public clubs for human betterment, and many other organizations financed by private subscription. Some of these private philanthropies parallel the public organizations, and bear study by the several boards to determine their various functions, and decide policies and areas of work. But in every community charitable agencies continue as separate entities; the engineer may discover his interest in either public or private boards of directors and should be represented.

When we say engineer we don't limit the profession to the male of the species. An example in all fields, we might say in passing, is Mrs. Lillian B. Gilbreth who, in addition to partnership in her husband's engineering firm and running her house-

hold of twelve children, served on countless educational, social-service, and defense boards.

In the field of health, public and charitable hospitalization, there exists control by lay boards. These boards, made up largely of business and professional men, offer opportunities for the engineer concerned with the physical well-being of the community. Here are deeply intermingled human and physical problems, demanding the thoughtful scientific treatment of complicated dilemmas. A man of broad aspects and engineering training can well serve his community in these humanistic fields.

Generous impulses spring from an inner source, a source that began in childhood with teachings of Biblical examples of good, and injunctions to do justly, and to love mercy, and to walk humbly before God. These impulses take expression in our daily lives, in all contributions we make in our citizenship. Whether we collaborate in the sphere of education, of public or private assistance, of civic aid, the moving force is the same; all of these activities bleed one into the other to integrate the concept and ultimate organization of a community. It doesn't matter where we lend our support, the functions are all vital to our humane form of life and government; what is important and what does matter is that the engineer *does serve*, that he gives of himself and his abilities for the general weal.

TRAINING OF THE YOUNG ENGINEER

By the time of graduation the opportunities enumerated herein for the exercise of good citizenship through public service ought to be better understood by the student in the engineering school.

History, languages, social sciences have received the "brush-off" in favor of the concentrated engineering studies. But for the better use of his engineering knowledge, a more comprehensive civic understanding ought to be offered, providing a background for the pure technical training.

The engineer, at the time of graduation, walks out into the world as ignorant of what makes the governmental wheels go round, as he is knowledgeable of what causes mechanical motion. He has not learned the relationships among the technical professions as a whole. The relationships of professional, business, and governmental functions, the elements by which the democracy operates, are largely unknown to him.

Various courses are offered in different colleges to give the student an understanding and perspective of his responsibilities as a citizen. This appears too incidental. It ought to be a well-thought-out, uniform, and combined effort on the part of all technical colleges to integrate social science with pure science.

As one example of what can be done, consider Georgia Tech's courses in community design, as they have been carried out in the last few years. These studies have stimulated in the architectural student an interest in what is happening and should happen in a large community. They have developed in the young engineer an understanding of what creates success or failure, growth or blight of an unplanned city. For the first time, perhaps, he has some conception of the facilities that a community needs to make it operate, and has an educational approach to an appreciation of citizenship.

The colleges might make some uniform move in this direction so that an engineer, starting in business or professional life, will have some knowledge of the community in which he hopes to make his living. He will learn in how many ways it offers him freedom and protection, and how, on his part, he may serve it.

Equipped with all the technical knowledge he can digest, the graduate goes out into the world, not only with small knowledge of the structure of the community, but with little or no knowledge of how to get along with people responsible for the maintenance of that structure. So it would behoove the college to give him also an appreciation of the people who guide the many organizations of the state, their besetting problems, and the various methods by which they may be helped by laymen. We must be sure that the college has done its part in instructing him in full understanding of the problems and possibilities of associating himself as a citizen with all the political entities under which he must live, and with all the business and social aspects of the everyday life into which he is being thrown.

As the engineering curriculum does not necessarily make a fine engineer, so neither does instruction in citizenship necessarily make a man with the right attitudes toward good government. This attitude of citizenship is only produced from within the individual, young or old, rich or poor, influential or insignificant. There must be a moving force that activates men of Roy Wright's stature. Returning to our definition, these qualities are: (1) Public-mindedness; (2) Creation of the right attitudes toward public duties; (3) Formation of habits of helpful, constructive, participating citizenship; (4) Development of activities which result in effective participation in good government.

The engineer's innate ability to determine the shortest distance between two points makes him invaluable in rendering service under various categories listed as opportunities for our ever-growing, complicated democracy. Indeed, straight thinking at all levels of government, and the expenditure of the substance of the population in the form of tax money, is a major question in the maintenance of and the development of our country. In these fields, the engineer must serve directly either as in a career, or indirectly as a volunteer in limited areas. We must help to maintain a simplicity and economy that will enable our government, with its multitude of services to the people, to balance the costs against the necessities of human existence.

At every level—city, state, nation, and among nations, duplication and complication beset our lives and confusion reigns. To help us clear the path of some of its debris, we recall the words of the famous industrial engineer, author of "Work, Wages, and Profit," "Organizing for Work," "Industrial Leadership," etc., Henry Lawrence Gantt:

"It is better to do inefficiently that which should be done, than to do efficiently that which should not be done at all."

What "should be done" appalls us; the engineer perceives it. He must train himself in the school of life to accept the challenge. He must prepare to take his place among his citizens, he must assume leadership, he must work fearlessly and imaginatively for and with his fellow citizens, he must represent not only himself in the community of nations, but the highest ideals and talents of the engineering profession. The citizenship that Roy Wright practiced stands as a noble example to all engineers:

1 Public-mindedness.

2 Right attitudes toward public duties.

3 Formation of habits of helpful, constructive, participating citizenship.

4 Application of procedures and processes which will result in the greatest good for the greatest number.

To his own training, to his own development, to his love of humanity, the engineer will to himself be true; he cannot then be false to any man.

Discussion of
13 QUESTIONS *Asked by* STUDENTS

By R. E. PETERSON

MANAGER, MECHANICS DEPARTMENT, WESTINGHOUSE RESEARCH LABORATORIES, EAST PITTSBURGH, PA. FELLOW ASME

AS a result of your student survey you have submitted 13 questions as a basis for discussion. The questions have not been changed; none has been omitted; only the order has been changed to facilitate discussion. It is of course impossible to attempt to answer these questions in anything but a sketchy manner, and furthermore, the answers are in some cases time-dependent (salaries, for example).

ENGINEERING OPPORTUNITIES FOR GRADUATES

Question 1 regarding job opportunities can best be answered by reference to Fig. 1 prepared for the Engineering Manpower Commission of Engineers Joint Council by Dean Hollister (1).[1] Note that the curve of estimated graduates drops to less than half of the estimated needed graduates. The estimate of graduating engineers is the most optimistic production possible, at least up to 1954, since this represents the presently enrolled students; the accumulated shortage by that time is estimated as more than 40,000 engineers (2). This indeed indicates a critical shortage of engineers; but the situation is even more acute in that the curves take no account of the effects of the Korean War and do not allow for withdrawals for military service. Note from Fig. 1 the drastic dip during the last war.

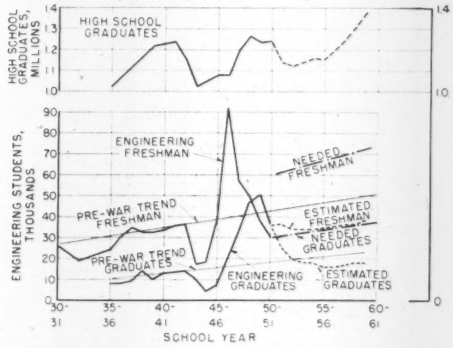

FIG. 1 OUTLOOK FOR ENGINEERING GRADUATES

(Actual and estimated enrollment by U. S. Office of Education. Needed freshmen and graduates estimated by S. C. Hollister.)

While there is some hope that as serious a mistake will not be made again, there is no doubt that we are now facing an especially critical shortage with respect to engineers and scientific personnel.

Questions 2 and 3 regarding types of mechanical-engineering jobs can be answered in part by reference to the 1950 membership of the twenty Professional Divisions of The American Society of Mechanical Engineers (Fig. 2). It should be borne in mind that the Divisions are not a product of the ASME staff or officers, but are created and developed by the members entirely in accordance with their interest and needs. In looking at the numbers, one must also remember that some of the Divisions are small because they are relatively new (such as Gas Turbine Power); for this reason organization dates are given on Fig. 2. It may be somewhat of a surprise that the Management group is the largest. This reflects the trend toward broader participation by engineers in company operation. Note the wide variety of industries represented; also note that certain basic fields are well represented (Applied Mechanics, third, and Heat Transfer, sixth). While it is possible in the ASME to register in as many as three Divisions, registration figures are believed to provide a rough measure of member interest.

Fig. 3 shows the approximate placement of 1949 engineering graduates and is believed to be a fairly typical pattern for the present years (3). That the federal government is a large employer[2] is perhaps not a surprise; but since the data of

[1] Numbers in parentheses denote References at end of paper.

[2] For example, the Naval Ordnance Laboratory employs over 700 engineers and scientists (April 1950), the largest single group being mechanical engineers (4).

As part of their recent four-day Annual Career Conference, the University of Illinois invited prominent alumnus R. E. Peterson to discuss thirteen questions bearing on industrial employment submitted by their mechanical-engineering students. Mr. Peterson, Manager, Mechanics Department, Westinghouse Research Laboratories, is a Fellow of ASME, and has been particularly interested in development of young engineers and the relations between universities and industry.

THE 13 QUESTIONS

1 Does the national economic trend indicate increasing job opportunities for college graduates?
2 What type of jobs are available in this field?
3 In what phases of mechanical engineering are there the most opportunities for employment?
4 What are the salary expectations in this field?
5 What is the attitude of industry toward higher degrees, i.e., masters and doctors degrees?
6 Is it better to start working in a small or large company, i.e., for getting practical knowledge?
7 How would you go about seeking employment if you were in our position at the present?
8 Do extracurricular activities hold much weight, i.e., would an interviewer rather see a man with better grades, or one with average grades and outside activities?
9 What are some of the assets an employer seeks in newly graduated students?
10 Do most companies have their own training program for college graduates?
11 What are the channels by which one may progress in this field?
12 What type of working conditions may one expect?
13 What satisfactions besides salary may one expect to gain from jobs in this field?

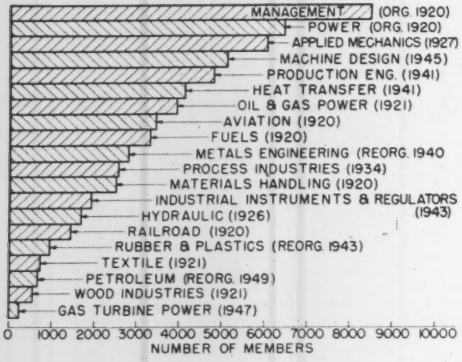

FIG. 2 PROFESSIONAL DIVISIONS OF ASME—1950

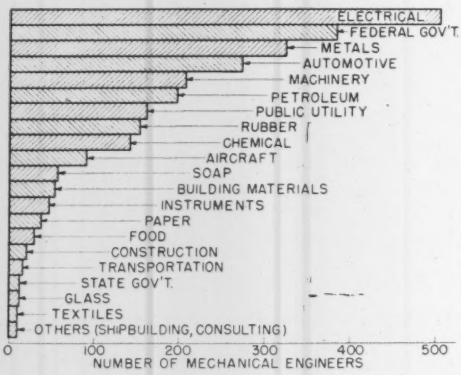

FIG. 3 MECHANICAL ENGINEERING GRADUATE PLACEMENTS—1949 QUOTAS
(Data from EJC Survey—1949.)

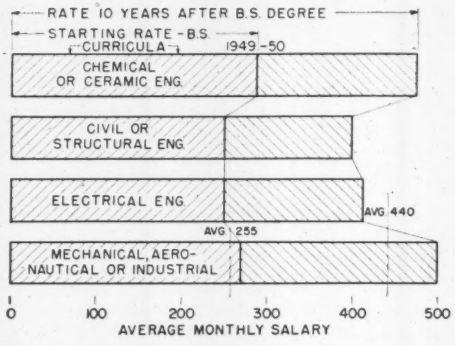

FIG. 4 SALARIES OF ENGINEERS ACCORDING TO CURRICULA
(Data from EJC Survey—1949.)

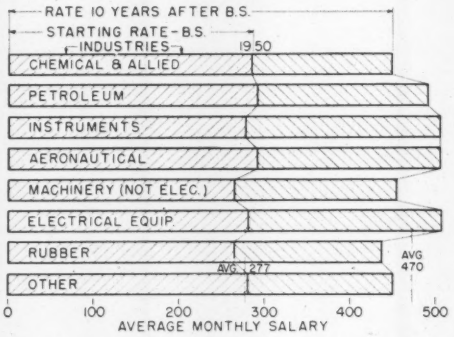

FIG. 5 SALARIES OF RESEARCH AND DEVELOPMENT LABORATORIES SCIENTIFIC PERSONNEL
(Data from Los Alamos Survey—1950.)

Fig. 3 are "pre-Korean," the federal government will probably become a still larger factor. This is also the case for the aircraft industry. It may be surprising that the electrical industry is such a large employer of mechanical engineers, but it must be remembered that (*a*) much equipment which is completely mechanical is produced by electrical companies—turbines, jet engines, etc.; (*b*) the major problems in developing electrical machines are quite often mechanical—strength, lubrication, vibration, etc. Note that the chemical and soap industries are relatively large employers of mechanical engineers.

It is quite clear from Figs. 2 and 3 that wide variety is found in the mechanical-engineering field.

SALARIES—DEGREES—SIZE OF COMPANIES—PLACEMENT

Questions 4, 5, and 6 deal in part with salary considerations. Let us first look at Fig. 4 which shows salaries of engineers according to university curricula (3). The differences are not large and it appears that mechanical engineers are not at a disadvantage. However, the data should not be taken too seriously, since surveys do not yield precise answers and furthermore the situation varies with time. Note that the survey is for 1949;[3] the starting figures seem to be about 15 to 20 per cent higher at present. Fig. 5 shows the results of a 1950 survey of salaries of laboratory scientific personnel (5) (not the same group as represented in Fig. 4). Fig. 6 shows that for laboratory work a PhD degree is advantageous. Those who have the opportunity and possess unusual ability should definitely continue with postgraduate work. The curves show that for a graduate with a BS degree the salary situation is about the same in industrial and government laboratories over the ten-year period following graduation; beyond this and for the PhD degree there seems to be some advantage in the industrial field. It must again be said that these results should not be considered as precise, since in some areas the number of items in the survey was insufficient and also the situation changes with time. However, in so far as the author knows, these figures represent the best and most recent information available and can be considered as roughly representative; as such, this would seem to be better than no

[3] A similar EJC survey for 1950 has come to the author's attention recently. This was not published in detail (a brief description was given in MECHANICAL ENGINEERING, May, 1950), but can be obtained by writing EJC (29 W. 39th St., New York 18, N. Y.). The results roughly correspond to those of the 1949 report; in fact some of the salaries are lower. As is well known, however, conditions have changed considerably in the meantime.

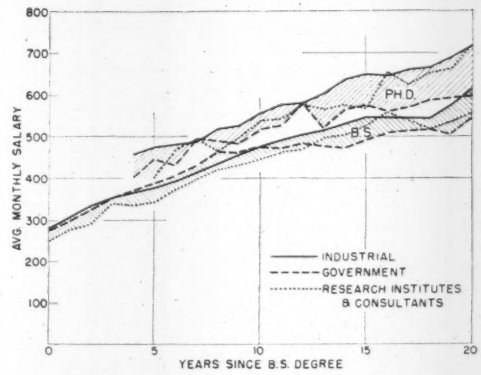

FIG. 6 SALARIES OF RESEARCH AND DEVELOPMENT LABORATORIES SCIENTIFIC PERSONNEL
(From Los Alamos Survey—1950.)

information at all. It would be a mistake to give too much emphasis to salary figures. As noted from Figs. 4 to 6, starting salaries do not differ greatly; the main consideration from then on should be doing an outstanding job, in which case the salary aspect need not be a source of worry.

As to small and large companies, the EJC report indicates slightly lower starting salaries, on the average, for companies having less than 5000 employees, but this is perhaps not a significant difference. In a quite small company it should be possible to get a better picture of all of the operations involved. On the other hand, the training programs, to be discussed later, are developed to a high degree in the large industries.

Question 7 concerns placement. The usual method of seeking employment is: Decide what you like to do, find out where such work is done (your professors can help you), write to such organizations, and arrange for interviews where possible. The last step is to be strongly recommended since correspondence is not as effective as a personal discussion (6). Certain universities offer a vocational-guidance service, even including testing techniques. Industrial representatives schedule campus calls; these should be viewed not only as an interview procedure, but as an opportunity to ask questions about industrial policies and operations.

PERSONAL CHARACTERISTICS

Questions 8 and 9 regarding personal characteristics will be discussed in terms of an ECPD survey (7) completed in 1948. Thirty-six personal characteristics as numbered and defined by Roget's Thesaurus (1937 edition), which includes definition of opposite characteristics also, were selected as being appropriate. These thirty-six characteristics were grouped into six general classifications, as follows: dependable, dynamic (professional energetic, drive), emotionally acceptable, intelligent, organizationally acceptable, and physically acceptable.

Each of these groups consisted of six items, for example, "organizationally acceptable" consisted of: co-operative, considerate, dignified, likable, self-possessed, and thoughtful. Check charts of these personal characteristics were sent to executives carefully chosen for their experience in hiring and directing young engineers with the request to rate the general classifications in order of desirability and also the six characteristics in each classification in order of desirability. The method of analyzing the data from the survey will not be discussed here, but it is believed that a reasonable method of indicating degree of desirability was developed. The over-all results are summarized in Fig. 7 wherein increasing desirability is indicated by increase in vertical direction. In case the meaning of a certain characteristic is not clear, reference to the opposite, Fig. 8, will be helpful.

The sloping dashed line of Fig. 7 is the "best line of means" and the angle which it makes with the horizontal may be considered as a measure of degree to which preference is expressed (i.e., if the dashed line were horizontal, no preference would be indicated with regard to the six groups).

Note from Fig. 7 that the *intelligence* and *dependability* groups top the list and that the *physical appearance* group occupies the position of least preference. Incidentally, the lower right-hand corner of Fig. 7 has had its domestic repercussions for the author—not only does he not co-operate sufficiently in promoting tidy appearances in two teen-agers, but he goes so far as to attempt to reinforce his position by utilizing technical charts! The answer, seriously, is that we are speaking only of *desirable characteristics*, and that we are concerned only with

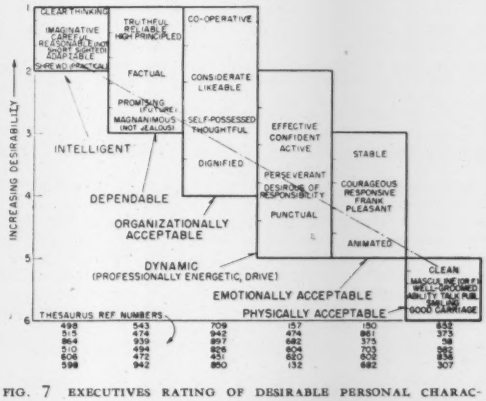

FIG. 7 EXECUTIVES RATING OF DESIRABLE PERSONAL CHARACTERISTICS OF GENERAL ENGINEERS
(From Survey in ECPD Report—1948.)

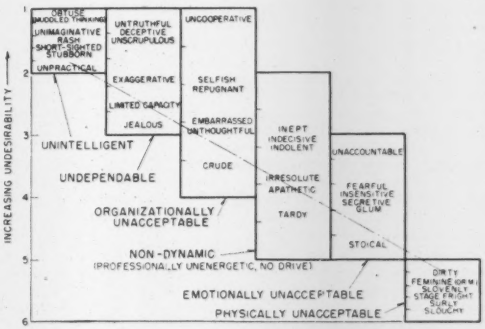

FIG. 8 EXECUTIVES RATING OF UNDESIRABLE PERSONAL CHARACTERISTICS OF GENERAL ENGINEERS
(From Survey in ECPD Report—1948. Actual rating was on basis of desirable characteristics. Opposite characteristics were, however, included in the listing of characteristics.)

preferences, sometimes slight ones as we shall see later.

It is apparent from Fig. 7 that executives desire most of all that the engineer should be *clear thinking, imaginative, truthful, reliable,* and *co-operative.* These are the specifications for a good engineer and also for the best type of engineering prospect. (By way of emphasis, the specifications for a poor prospect are found at the top of Fig. 8: muddled thinking, unimaginative, untruthful, deceptive, unco-operative.)

Note from Fig. 7 that *clear thinking* is the top item; perhaps it will not be out of order to discuss this at some length, since in this age of many diversions, certain fundamentally important items are apt to be overlooked.

In the opinion of the late Dr. Doherty (8) much of our education is afflicted with "subjectmatteritis." He characterizes the memorizing of unorganized facts as "quiz kid" learning. Doherty mentions his association with Steinmetz:

> Within my limits, he taught me how to think. Experience has demonstrated that a trained mind will make its way in new situations, even if the particular subject matter and techniques involved have not been learned in college. . . The simple fact was, I had not learned to analyze a situation in terms of general principles. I was looking for a formula and there was no formula; a general principle or concept was all that could help me. . . . The ability to think straight and constructively has to be learned by actually doing such thinking. The ability to think does not come simply when subject matter is learned, nor is it absorbed by merely listening to a teacher. It is won by struggle.

Doherty also mentions the ability to organize thought for clear logical expression:

> This quality might have been defined more simply as the ability to write well, but it implies more than this usually connotes. It is more than the ability to use good diction, phraseology, and punctuation; these are largely matters of rule, technique, and reading, and are, it appears, reasonably emphasized in school and college. The ability to which I refer, however, involves constructive thinking—organizing a logical thought structure out of the welter of random ideas that press for outlet when one undertakes to write. As such, this ability becomes an aspect of the scientific habit of thought and is thus an essential objective of the educational program.

Professor Highet (9) of Columbia University has expressed the viewpoint of the teacher with regard to the importance of logical thinking:

> It is the teacher's chief duty to train the minds of the students. That is even more important than filling them with the right facts. . . The ability to think is the most important of all, for it changes them into human beings. Some of them never learn it. Uneducated people all over the world seldom learn it. That is why there is such a terrifying gulf between those who can think generally and logically and those who cannot. Those who can think for themselves see the world as a complex of events and forces which can be explained by fitting them into a number of intellectual patterns.
>
> Those who have never learned logical thought can seldom see these patterns. Usually they refuse to believe that the patterns exist. They substitute vague and sullen emotional burps for logic. Or else they believe—when one tries to explain the pattern to them—that the explanation is only 'a lot of talk,' words, words, words, intended to deceive and not to communicate. . . .
>
> So when we teach . . . we must remember that, for a good deal of the time, they are trying—not always with success—to think as we think. Our minds are trained to put two and two together. Their minds are not trained to put anything together except emotional experiences. Our minds can detect remote similarities and build up large patterns of thought. Their minds cannot make those jumps and fill in those connections.
>
> Almost automatically, after our training, we single out cause and effect, principle and example, rule and exception, pro and con, general and particular. These very concepts are strange to the uneducated.
>
> Therefore the good teacher will always remember that it is not only the subject-matter of his teaching which is strange to the class: it is the actual method of thinking.
>
> The best teacher in the world cannot force the student to grow in mind to his fullest powers. All that he can ever do is to help and to encourage. His best reward is to see, not a "product," but a free and independent human being who can think.

Unfortunately there are some individuals, although these are few and decreasing in number, who actually discourage curiosity, fundamental thought, and a high type of scholarship. As engineering students, do not at any time become confused about your education—its most essential purpose is to *develop thinking minds;* and remember that *executives rate this as the most desirable personal asset.*

It is tempting to devote more time to this vital point, but we must return to our charts and then complete our review of the list of questions.

Fig. 7 refers to general engineers. The survey attempted to develop similar ratings for classes of engineers—research, design, production, management, sales.

The results for research and design engineers came out so closely that one chart may be used for both. This chart (not given here) is similar to Fig. 7, except that the slope of the "best line of means" (Fig. 9) is somewhat steeper and that *clear thinking* stands out even more conspicuously—*imaginative* next.

The results for production and management engineers can be roughly grouped together for chart purposes. Here the slope (Fig. 9) is less and the following characteristics stand out: *clear thinking, co-operative, truthful, high principles, stable.*

Sales engineers, as might be expected, are more difficult to chart, the scatter being much greater. The faint dashed line of Fig. 9 indicates that, roughly, all categories are about equally desirable. The actual chart (not shown here) shows the following characteristics high in the list: effective, confident, active, clean, clear thinking, truthful, reliable, high principles, factual—without particularly strong preference.

As to what elective courses to select this will need to be decided by the individual student. It is suggested that you do not disregard your natural likes and dislikes in this connection. As to personal characteristics, much of this development is up to you as an individual and is not affected particularly by course selection. Extracurricular activities can be

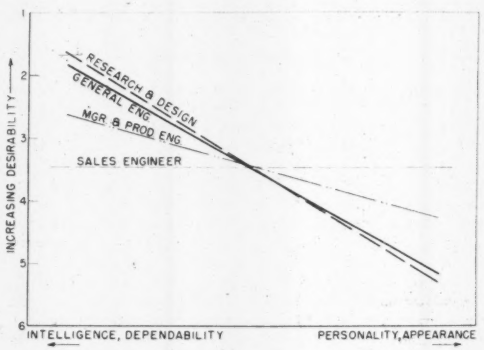

FIG. 9 ORDER OF DESIRABILITY OF PERSONAL CHARACTERISTICS FOR DIFFERENT CLASSES OF ENGINEERS

(Summary of "best lines of means" from ECPD Report—1948.)

helpful in the development of a co-operative, likable personality. (Note from Fig. 7 that *co-operative* is a highly preferred characteristic.) Extracurricular activities, hobbies, etc., are always scanned by those engaged in recruitment. The main point is to strike a reasonable balance—it is not to your own best interests to have no extracurricular activities, and of course on the other hand, such activities can be overdone.

TRAINING PROGRAMS

Question 10 concerns training programs. It can be said that a properly conceived graduate training program fulfills two important needs: (1) orientation and (2) specialized training. It is of course vitally important that the graduate find the place where his capabilities can best be developed. We have found that many graduates come to us with gross misconceptions of the basic natures of various industrial jobs. Some are surprised how much solid engineering is required in sales, how much hard work of a painstaking character is necessary in research, etc. To get straightened around, once and for all, early in the game is important for both the individual and the company. Imagine the difference in a company in 10 or 20 years with a large number of promising men in their best locations as compared to not the best locations.

Specialized training is valuable, not so much for the information itself, important as this is, but for providing an opportunity to continue studying. Most engineering graduates go through a period of several years which has been called a "postcollege slump"; this can be countered to a large extent by an effective graduate training program conducted jointly by industry and local universities. Dean Hammond (10) points out that of the fifty industrial communities in the country, only ten have provision for part-time graduate work. The writer strongly advises the graduate when going into industry to make specific plans for future education. This should not be put off with the idea of considering it later on.

PROFESSIONAL DEVELOPMENT

Questions 11, 12, and 13 which deal with professional development have been discussed in part in the foregoing. Participation in technical-association activities is one of the important steps in professional development. But, the student might ask: Do companies look with favor upon considerable "external" activity? It is true that in the past some companies have not taken an enlightened view of association activities, but the present situation is a healthy one. This, incidentally, has not been brought about by benevolence or a philanthropic attitude—companies have found out that sound technical-association activity is good business.

The following policy has executive approval in the company with which the author is associated and is cited here only as being typical of the out-look of the majority of well-managed companies.

1 Active participation in engineering societies by every qualified employee should be encouraged; such participation should be regarded as part of the man's normal and regular work.

2 A good engineering development job is not finished until the noteworthy engineering uncovered has been (*a*) presented at the proper time before a national technical society, and (*b*) that the pioneering knowledge of the company is made part of the permanent engineering literature.

3 Membership in at least one engineering society is a definite responsibility of any company employee who regards himself as a member of the engineering profession.

Engineering is a profession comparable to the medical and legal professions. There seems to be more of the prestige element in the latter two fields, but there is every reason for the engineer to be proud of his profession which produces such an array of amazing products and which becomes such an important factor for survival in case of military necessity. Dean Young (11) has traced the growth of the engineer, particularly over the last century to professional status, and it is clear that technical progress has proceeded more smoothly than professional progress. To play a part, however small, in developing the professional status of the engineer, through technical-society activities or otherwise, can be a real source of satisfaction.

Finally, as young engineers you should strive to develop intellectually beyond the confines of the technical field (12). You should become interested in your government and in foreign affairs in order to become well-informed citizens. You should pursue at least one interesting hobby, outside of the technical field.

Wickenden (13) has expressed a philosophy which should serve as an inspiration for anyone who aspires to become an engineer in the true sense:

> Every calling has its mile of compulsion: its round of tasks and duties, its prescribed man-to-man relationships, which one must traverse daily if he is to survive. Beyond that is the mile of voluntary effort where men strive for special excellence, seek self-expression more than material gain, and give that unrequited margin of service to the common good which invests work with a wide and enduring significance. The best fun of life and most of its durable satisfactions lie in this second mile, and it is only here that a calling can attain to the dignity and distinction of a profession.

The question of what "satisfactions one may expect" can be answered by saying that in general these do not come automatically; if you will travel the second mile you will be rewarded with many satisfactions, the best of which will be the unexpected ones.

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Reducing Costs Through ACCIDENT-PREVENTION ENGINEERING

By J. V. GRIMALDI

DIRECTOR, INDUSTRIAL DIVISION, ASSOCIATION OF CASUALTY & SURETY COMPANIES, NEW YORK, N. Y.

INTRODUCTION

AFTER forty years of successful demonstration, it is shocking to find that there are still many who do not understand the value of accident prevention. This lack of perception cuts across all lines and classes of individuals. Why this should be cannot be answered. Apparently, experience is not a great teacher. Today, as in the beginning, the safety engineer is compelled, by this persistent general lack of a sense of value, to "sell" the doctrine of accident prevention. The believers have grown in number, to be sure, and the results of their experiences have made them devoted disciples, but the many outside the fold represent a major problem.

A question before all safety specialists is, "How can we reduce the barriers of nonacceptance?" Some say the answer will be reached when accidents are described in terms of dollars. Many have attempted to do this. Although their efforts have been able, the solution certainly cannot be considered complete. But each new attempt probably has a wearing effect on the obstacle.

This paper is offered as another piece of evidence, which, if not conclusive in its resolving influence on the problem, may serve to increase the wearing effect, by irritation, if by nothing else.

RELATION BETWEEN PRODUCTION AND SAFETY

Industrial expense is a function of the efficiency of production. Therefore the problems of the executive center about the problem of production. Industry, to be sure, has other problems besides production, but no other that comprehends so much. The principal purpose of the factory is to produce and to do so efficiently. Therefore it was logical that an early attempt (1928), to relate safety to savings should be made through the medium of a study of the safety experience of a large cross section of American industry and the corresponding production record. The problem was to determine the relationship, if any, between production and safety. The study was conducted by the Committee on Safety and Production of the American Engineering Council after surveying 13,898 companies, representing a total number of 54,430,707,000 man-hours worked. A principal conclusion was that, "Maximum productivity is ordinarily reached only when the accident performance tends toward the irreducible minimum."

The cost of industrial accidents was brought to prominence by H. W. Heinrich when he reported that for every dollar spent directly for accident costs, there are four times as many dollars expended for the indirect or hidden costs associated with the accident. This ratio at best is just an approximation when applied to individual or small numbers of accidents. However, experience seems to prove that it does hold relatively well for large groups of accidents. Therefore it has become a "rule of thumb" for measuring total accident costs.

Contributed by the ASME Safety Committee and the Management Division, and presented at the Annual Meeting, New York, N. Y., November 26–December 1, 1950, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

In 1950, for example, the Associated General Contractors of America reported on "Two Exhaustive Accident Studies." Relating the studies' findings to a contractor doing a million-dollar construction volume during the year, he will have a payroll of $400,000 (based on the average for the industry), and a total of eight accidents, which will cost him at least $42,000. The report, in the interest of conservatism, applied a factor of only two to allow for the hidden costs of accidents. Insurance covering the direct cost will underwrite $14,000. This leaves $28,000 or 7 per cent of the contractor's payroll to be charged to the additional expense of accidents.

The report of the Associated General Contractors surely must be interesting to anyone representing management and it should be persuasive. Yet too often the reaction is, "This in general is entirely correct, but my operations do not follow the general rule." Perhaps this is a reasonable attitude and, therefore, it might be helpful to demonstrate the cost savings of accident prevention, using case histories.

To develop the necessary information, we made a survey and requested examples demonstrating the effectiveness of safety engineering, measured by dollars saved. A sampling of the case histories reported will be presented here. As they are read, it should be observed and remembered that the safety-engineering axiom, "The same factors that cause accidents cause production delays," applies in every case. It will be noticed that, although the operations involved in the case studies have been overly expensive aside from the cost of accidental injuries, the means for effecting savings were not applied until the operation was revised so as to reduce hazards.

EXAMPLES OF EFFECTIVE SAFETY ENGINEERING

Fertilizer Plant Reduces Accident Costs. A fertilizer plant employing 819 people before undertaking safety engineering service had an annual dollar loss due to accidents of $286,500. If the reader is interested in data, the accident-frequency experience prior to the safety program was 40.51, and the severity 8.53. Within one year after the program the frequency was reduced to 20.56 and the severity to 0.61. The man-hours worked in each case were well over a million and a quarter. The cost of the safety program was $48,520, but the difference in the amount of money paid out for accidents after the installation of the program compared to before, was $221,360.

Safety Engineering in Aircraft Production. An aircraft plant employed a battery of punch presses to blank out small runs of pieces for brackets in airplanes. The safety engineer made a routine analysis of the operation to determine its potential hazards, although the setup was new and no accidents had occurred. His analysis showed that there was a strong possibility for severe injuries. As a consequence, he submitted a redesign of the dies. The suggestion was followed at a cost of under $50. It involved the use of the same dies with certain relatively small additions.

Prior to the new dies, the old system produced 8 pieces per minute. After the new installation, 25 pieces per minute was the rate—a production increase of over 300 per cent.

Also, there was complete elimination of all possibilities for accidents during the operation. The dollar savings through increase of production can be clearly seen. But the outstanding point here is that it was accomplished by merely eliminating the safety hazards.

The engineer was not concerned with increasing production as his sole objective. His responsibility was the elimination of hazards. However, because the same factors that cause accidents also cause production delays, his redesign had a beneficial effect on the productivity of the operations.

Losses Turned to Profits in Woodworking Plant. In one department of a woodworking plant, 50 women were employed at jobs that seemed to be the least hazardous in the plant. Wooden bottle caps were processed here by drilling them halfway through the center, then spraying them with paint and tumbling them to produce a smooth, satiny finish. Metal caps (produced by a subcontractor) were then pressed into the wooden caps and the completed product was packed in cartons.

The drilling produced the problem. Each woman was expected to turn out 25,000 pieces per day—a total of 250,000 for the 10 machines being used. However, in the course of a day there frequently was an interruption in production, due to accidents. It was estimated that this particular product was costing the company $2^1/_2$ cents per piece to produce. The contract gave the company only an approximate $2^1/_4$ cents per piece—a loss of $625 per day for this department.

A safety engineer discussed the problem with top management and made a serious study of the situation. He designed an automatic feeding rack so that the operator's hands were completely out of the danger area and so that the machines could be fed more quickly than by the hand method previously employed.

Four and one-half hours after the new automatic feeder was installed on a test machine, the daily quota for the machine was reached. The other 9 machines were then similarly equipped. Almost immediately production jumped to an estimated daily output of 875,000 pieces at a cost to the company of 0.011 cents per piece, a daily profit, with the improvement, of $9,843.73. The accidents were stopped, thus further increasing the company's profits by decreasing insurance costs and other hidden costs.

The contract was filled 54 days earlier than expected, and its prompt completion resulted in another contract.

Safety Guards Improve Sheet-Metal Production. A medium-size sheet-metal company had a particularly poor accident experience. It averaged 51.6 lost-time accidents per million man-hours worked, while the national average for the sheet-metal industry was 14.5. The accident causes were many but the worst hazard was associated with unguarded punch presses. In the preceding years, many types of guards had been recommended by various people but none was found to be practical. The company, as a result, began to lose faith in the advantages of safety guarding. However, finally a qualified safety engineer recommended a guarding method that was both effective and practical. His problem was a greater one than would be found in many ordinary cases of guarding. Management and employees were generally dissatisfied with guards, and their opposition had to be overcome.

One machine was guarded as recommended, for experimental purposes. After a one-day trial, it was found that production had been increased from 8000 units per 8-hr shift to 12,000, a substantial 50 per cent increase with the new guard. The cost of the guard was $115. The savings were determined to be $3.60 an hour. For 300 working days in a year, the annual savings in labor costs amounted to $1080. Similar guards were then placed on the other machines.

There were other savings too. Obviously, since the production of the machines had been accelerated, they were released that much sooner for other jobs. Then too, the insurance savings that came from a lower accident-frequency rate were great, inasmuch as the reduction was from a high frequency and severity to a much lower one. Therefore the plant's overhead was reduced considerably.

Removal of Hazards Speeds Production. Even though hazards exist, they do not always result in an unusual number of accidents, but their presence does slow production. A plant manufacturing artificial brick-siding panels had not had an extraordinarily poor accident experience. However, an engineering survey made by a safety engineer uncovered a situation which indicated a prominent accident potential. He revised the process, mechanizing it so that the hazards were removed completely. His intention, it must be remembered, was to eliminate hazards primarily. Let us look at the record and see all that was accomplished.

Before:	
Number of employees	40
Accident frequency	10.4
Severity	0.44
Lost-time accidents	1
Workdays lost	53
Compensation paid	$240
Production average, units per hr	8
Production man-hours required per year	96000
After:	
Cost of improvement	$26000
Number of employees	18
Accident frequency	0
Severity	0
Production average, units per hr	40
Production man-hours required per year	43200

Here it is seen once again that a safety improvement, while it accomplishes its objectives of accident prevention, also materially increases production. In this case the production was increased from 20,000 units per year to 67,000, with a saving of 52,800 man-hours, requiring 22 less workers. But that isn't all. Before the safety improvement, the company suffered a loss in this department of $1 per unit. After the installation, the units were produced at a profit of $2 each.

SAFETY SHOULD BE PRACTICED BY EVERYONE

Some things never become popular due to impracticality or lack of interest—others, regardless of their potential practicality and interest apparently have difficulty achieving popular support. One of the latter seems to be accident prevention. Although safety, like religion, should be practiced by everyone, there are only a comparatively few who follow its precepts wholeheartedly. Why this should be is difficult to understand, but some have said that a partial answer may be found in the lack of comprehension of the material values of accident prevention—in addition to the altruistic.

Many reporters have indicated the relationship between safety and production, and the hidden cost of accidents, over and above the direct cost for insurance or medical care and compensation payments. Perhaps more of such information is required, for the way of our modern life conditions one to look for practical considerations first. The foregoing case reports are presented, therefore, to illustrate the very real returns from the application of safety engineering. They are not outstanding examples but may be considered typical of what can be done for industrial operations when qualified safety engineering is given the opportunity. Perhaps the most important observation, following a review of the reports, is that often the

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SUPERVISOR'S PART *in the* LABOR AGREEMENT

By HARRY F. GRACEY

DIRECTOR OF MANAGEMENT DEVELOPMENT, SKF INDUSTRIES, INC., PHILADELPHIA, PA.

AT one time or another we have all experienced the approval or disapproval—audible or silent—of the men down the line in supervisory positions who are handed a labor contract and directed to go out to the shop to put it into practice. We have listened to the proverbial gripe of the foreman who claims that "they" (meaning top management) made this contract with all its legal detail and, although he doesn't always agree with the results, "guesses he will have to get along with it." Not a few times we have heard these men say, "Now if they had asked my opinion, I would have given them a better steer on this seniority clause" or "this wage equity thing," or "the incentive rates," or "transfer and overtime," or a hundred other things daily affecting his departmental operation.

Back in 1947 we began to listen seriously to our lower echelons of management on these and other contract suggestions. What we found was good and has continued to improve in its effectiveness as 150 men began and continue to participate and lend their individual and collective talents to the development and steady improvement of the collective-bargaining pattern from year to year.

These men began with the third-shift first-line supervisors and foremen and included every level on up to the plant superintendents and managers. Everyone was given the opportunity to make his recommendation to the company members of the bargaining committee.

Here is how it works.

AGREEMENT MAKING

The company applies the principle that the greater the participation of supervisors in the agreement, the greater their interest in problems that arise in its application. In consequence, a more informed administration at all levels makes for better labor relations.

Several weeks before the company drafts its proposals for union negotiations, the general factory manager appoints a committee of supervisors to meet with a representative of the Personnel Division, who acts as chairman. As the latter is a member of the company's negotiating committee, a close link is formed between the negotiating committee and the supervisors' committee. Thus supervisors are assured that their suggestions reach the company's negotiators.

The committee of supervisors appointed by the general factory manager includes various levels of supervision, representative of different areas within the factory organization; in this way a cross section of problems is exposed. Members gather the ideas and suggestions from the supervisors they represent. These suggestions are discussed and weighed by the committee, some being discarded and others designated for consideration as major or minor.

Contributed by the Management Division and presented at the Annual Meeting, New York, N. Y., November 26–December 1, 1950, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

REPORTS ON NEGOTIATIONS

One of the members of the negotiating committee is delegated to report on the bargaining sessions to the supervisors, in group meetings. In addition to the factual developments, the atmosphere of the negotiation meetings is also conveyed in order to give the supervisors as much a feeling of being a part of the negotiations as possible. Questions are answered, demands and counterdemands are analyzed.

These meetings with supervisors are timed with care and are held frequently. On some occasions, when it is felt that "hot" news should be transmitted immediately, meetings are conducted while negotiations are in session.

At the close of negotiations, the chairman and several members of the negotiating committee meet with groups of supervisors and review each clause of the labor agreement. The clauses in which there has been no change are commented upon; those which are changed and all new clauses are dwelt upon at some length. The meaning and application of each is explained and questions are answered.

OBJECTIVE TECHNIQUES

This participation in the development of the labor agreement obviously familiarizes supervisors with its content, and, as stated by a representative of the Personnel Division:

"There is little question that our supervisors, at this point, have some knowledge of the agreement, but how much? How will they interpret it? How will they apply it? Each supervisor has his own impression of what has been told him. Our experience in the grievance procedure has indicated that there is considerable divergence in their opinions of the meaning of the terms of the agreement and consequently the result is not too uniform an interpretation in the early stages of the grievance procedure."

The company meets this problem through various quizzes, supplemented by conferences, popularly known in the company as the "Do You Know?" series, abbreviated from "Do You Know the Labor Agreement?" Supervisors are assured that results of any quiz will not be used as a measure of ability. Each gets back his marked quiz, but individual scores are held confidential by the Personnel Division. However, the total average scores of groups of supervisors are released to encourage some competitive feeling.

The company quiz has been constructed skillfully. It clearly shows evidences of expertness in testing technique. It is not a conglomeration of material from the labor agreement. It does not contain "trick" questions, nor does it burden supervisors by requiring information on obscure points. Instead, it is specifically aimed at developing an awareness of information that supervisors need for day-to-day administration. The purpose is to enable them to avoid many problems in employee relations, and to handle, in the early steps of the grievance machinery, a substantial proportion of the problems that do arise.

A preliminary version of the quiz was tried out on two pilot

groups and was changed a number of times before it was administered to the supervisory force. Particularly helpful in developing the quiz was an advisory group selected from the divisions of the company most interested in certain sections of the agreement; for example, the payroll and standards department helped to draw up questions pertaining to a section on wages.

SUPERVISORY CONFERENCES

The company's regular weekly supervisory communication meetings immediately preceding the scheduled date for the quiz are devoted to discussions of the labor agreement. Once the quiz is scored and the answers analyzed, the next step is to use the results constructively. In order to do this, the questions are grouped (each question being numbered) by articles of the agreement, and the correct answers are indicated. An outline of the conference method was developed so that conference leaders could be taught how to use the answers to quiz questions as a basis for conference discussion of the interpretation of the labor agreement. The questions the supervisors answer incorrectly are, of course, principal topics of their discussion.

While the conferences with supervisors are in session, a member of the Personnel Division is present to assist the conference leader if he asks for assistance, and to record any questions which cannot be answered in the conference. When answers to such questions are determined, they are submitted to the conference leaders before the subsequent meeting.

Subsequently, in the regular weekly conferences, supervisors become acquainted with changes in interpretations and new and unforeseen problems that arise in administering the agreement throughout the company. These conferences serve as a two-way communication line and are of as much benefit to the Personnel Division as to the supervisory force. Quite frequently representatives of the Personnel Division are invited to attend these meetings.

FURTHER DEVELOPMENTS UNDER WAY

As yet the company's program has not been developed fully, and probably will not be for another year or so. In the planning stage now is another "Do You Know?" quiz. This will consist of a number of problems requiring the interpretation of one or more clauses of the labor agreement. Supervisors will have copies of the agreement at hand during the quiz and will use them as references. This quiz, too, will be followed up by conferences; the general mechanics of administration will be somewhat the same as that described for the first quiz.

Also in the preliminary stages at this time is a "grievance clinic." It is hoped to develop a pattern of grievance analysis that will assist supervisors in handling grievances. Supervisors will have an opportunity to bring grievances from their own departments for analysis under the direction of a conference leader especially trained for this work.

Eventually it is intended to enlarge the scope of these clinics to include discussions of labor laws, bargaining techniques, pregrievance problems, and other pertinent subjects that have to do with labor and personnel problems in the supervisor's own department.

CONCLUSION

The lower echelons of supervision have a very important part to play in the labor-management relations of the author's company. Not only are their ideas incorporated but their sleeves are rolled up in active daily participation. The "guess we will have to get along with it" phrase is a thing of the past. On the one hand we see pride of accomplishment; on the other, sincere understanding of the power of sound bargaining in the event that some suggestions must be modified or even eliminated for the time being—good as they might be. In either case, the satisfaction of knowing "why" certain actions are taken has created a strong well-knit, hard-hitting management team of which we are very, very proud.

Engineering in Forest Protection

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cals have barely been investigated. Application of aircraft in actual suppression work is in its infancy. The helicopter faces a bright future, especially in wilderness country.

It is extremely important to clarify one point. The entire process of development of mechanized equipment is one of continual evolution. No machine is perfect at its inception; the uses to which machines are put in woods service are little short of brutal and imperfections are discovered. Improvements result from use and as a result all apparatus nears perfection with passage of time.

CONCLUSION

For purposes of summary it is apparent from the foregoing discussion that engineering techniques are indispensible in protection of forest resources of the nation. Engineering procedures are especially necessary in developing and manufacturing all of the classes of machine units required to suppress forest fire. Orderly application of the sciences of engineering has proved successful and superior to other attempts at equipment development. Organizations that have followed this procedure have won the leading positions in the sciences of fire control, and have solved in great degree the problems which confront them. It is true that efficient and well-equipped research centers have been found necessary to carry on the programs involved, but, inasmuch as manufacturing schedules can also be accomplished, these facilities result in public economy and efficient service.

Reducing Costs Through Accident-Prevention Engineering

(*Continued from page 493*)

needless expense of an operation is not apparent until the operation has been analyzed for hazards.

Defects—either human or mechanical—cause accidents. They also reduce production efficiency. Without disregarding the need for correcting human errors, the primary function of safety engineering is to achieve a physical environment that, within practical limits, will assure the safety of personnel, equipment, and material regardless of the mistakes made by people.

It is for this reason that the safety-engineering approach and changes indicated in the case studies were responsible for substantial dollar savings that were not accomplished previously.

Wherever there is a potential hazard to personnel, there is probable cause for production delay. The degree of influence of the hazard on production and safety is not necessarily a straight-line relationship. But what difference as long as the possibility of the relationship exists?

Can anyone afford to overlook what accident prevention has to offer?

UNESCO'S ACTIVITIES *and* POSSIBILITIES

As Viewed by an Engineer

By R. M. GATES

EJC REPRESENTATIVE ON U. S. NATIONAL COMMISSION FOR UNESCO

UNESCO, the United Nations Educational, Scientific, and Cultural Organization, started out with a mandate "to contribute to peace and security by promoting collaboration among the nations" by activities in the three fields mentioned in its title. But education, science, and culture are very broad terms. Almost any kind of program or project could be related to one of these fields. A bewildering variety of suggestions were offered, for representatives of more than fifty nations and of many occupational interests could point out a bewildering variety of needs around the world. It was only natural that confusion and diffusion attended the early activities of UNESCO. In response to pressures from many sources, it tried to spread its limited resources and facilities over a wide range of projects—to ride off in all directions at once, one might say. This is what a group of representatives of many occupational backgrounds and many races and nations would almost inevitably do in a new venture of such broad and vaguely defined scope.

Some of these activities, nevertheless, have already shown worth-while results. In three years, voluntary groups in the United States were responsible for sending over $200 million worth of materials and supplies for reconstruction of educational, scientific, and cultural institutions in war-devastated countries. UNESCO was active in publicizing needs and the Commission for International Educational Reconstruction in this country co-ordinated and stimulated the activities of voluntary organizations related to educational reconstruction.

The "adoption" of overseas schools and universities by American institutions was stimulated; also the sponsorship of training of foreign students in schools here and in Europe was extended. Educational equipment and materials have been furnished to some needy areas. A campaign against illiteracy is in operation in several areas with the successful one-teach-another system. A pilot project in fundamental education in the Marbial Valley of Haiti has attracted international attention. And not least in importance, the bringing together of scientists, educators, sociologists, and others from many nations, to canvass needs and ways to meet them, has obviously been a substantial contribution to mutual understanding among leaders in those fields, and with the presence of government officials it has stimulated plans by individual governments along the line of UNESCO objectives.

The experience of the past three or four years has led to some shaking down of the diffuse UNESCO program, and it appears that this process will continue. The idealism that prevailed at the outset, no doubt quite properly, is being tempered somewhat by a growing realism. It is more clearly understood that the world cannot be made over by UNESCO, that urgently needed and practicable short-term projects that serve long-term ends are preferable to attempts to leap to distant goals, and that the limits of the resources and facilities available to UNESCO require more concentration of effort. It is realized also that UNESCO as a catalyst, starting activities for others to carry on, may be more effective than UNESCO as a continuing administrator of projects it plans.

The United States National Commission for UNESCO, set up by act of Congress in 1946, is designed to furnish UNESCO advice and support. It has 100 members, of whom 60 are nominated by voluntary organizations in educational, scientific, and cultural fields and 40 represent federal and state governments and broadly the public at large. There are also state UNESCO councils in ten states. The members of the National Commission have naturally had the same difficulty as the members of UNESCO in reaching a consensus. Geographers, physicians, economists, sociologists, agriculturists, lawyers, clergymen, businessmen, engineers, labor leaders, and diplomats are likely to have different views of priorities among the world's needs and of ways of meeting the needs. The "shaking down" process, however, has set in there, too.

It seems to an engineer (1) that theory is more largely represented than practice on these bodies; (2) that the engineering profession ought to be more largely represented on both UNESCO and the United States National Commission, for many of the things that need most to be done "to contribute to peace and security" are in part or in essence engineering jobs; and (3) that "science" should be interpreted to include applied science, instead of mainly "pure" science, as is now the case, since the immediate needs for science in most areas are for its practical applications.

Whether or not adequately represented on UNESCO and the United States National Commission, the organizations of engineers in this country and abroad can do much to serve the purposes of UN and UNESCO, not only through collaboration with these and other public agencies but also through their own domestic and international facilities. Engineers have been internationally minded and internationally active for generations. World Engineering Congresses were held even back in the nineteenth century. And engineers have scattered round the world as their services have been required from time to time.

Iron curtains offer the least resistance to engineering, because engineering is very much the same the world over. Even within the Soviet orbit, engineers probably take less seriously than most others the official communist interpretation of American attitudes and purposes, because they get direct and objective information of the activities of fellow-engineers in the free nations. And peoples not yet behind the iron curtain may be helped to stay outside if engineering aid is given them toward solving their most urgent problems.

Many peoples have had reason to dislike or suspect foreign developers of their resources. Yet they welcome engineering surveys and other technical assistance which will show them how they themselves can make better use of their resources without upsetting their whole pattern of living. And some

nations have invited and welcomed surveys intended to guide the investment of needed foreign capital. The more a proposed development is directly and obviously connected with the welfare of the people, and the better it is planned with social as well as economic understanding, the easier it is to enlist the local co-operation that will make it beneficial to all concerned. American engineers have had a part in many such foreign projects—private and semiprivate and public.

Enterprises based on engineering may open doors for UNESCO and provide a parallel economic program. On the other hand, UNESCO's activities may disclose needs for engineering aid and for investment of private capital on appropriate terms. Extensive co-operation between UNESCO and the engineering profession seems eminently desirable, even essential, in this world situation.

A practical plan of collaboration between UNESCO and international engineering organizations was agreed upon at Paris, in March, 1950, by the Engineers Advisory Committee to UNESCO. Representatives of engineering organizations from England, France, India, Italy, The Netherlands, Sweden, Switzerland, and the United States were present. The meeting was called by the Director of the Natural Sciences Section of UNESCO, and three members of the UNESCO Secretariat were present.

A constitution for a Union of International Engineering Organizations was adopted, with these stated "principal objects:" (1) To co-ordinate the activities of the member organizations; (2) to make mutual arrangements for material and moral support; (3) to further relations with UN and its specialized agencies; and (4) to encourage the foundation of new engineering organizations in fields not already covered.

Fifteen international engineering organizations were invited to send delegates to an organization meeting which was held in Paris in September. These include the international federations, associations, institutes, or conferences in many diverse fields; railways, large dams, electric systems, gas, soil mechanics, irrigation, hydraulic research, bridges, navigation, welding, and others. The World Power Conference is among them. Eligible organizations must be concerned with international collaboration within the field of engineering and must have either an effective national committee or a substantial number of members in at least ten countries.

The Engineers Joint Council, representing the five United States societies of chemical, civil, electrical, mechanical, and mining engineers, are dealing with engineering organizations in other American countries to form a Pan-American Union of Engineering societies. A preliminary conference was held in Rio de Janeiro a year ago. This organization should be an important factor in international co-operation and in furthering UNESCO's plan.

A conference on a plan related to the general subject, "How Engineers Can Promote International Understanding," was held in New York in July between members of the Engineers Joint Council, other representatives of American engineering societies, and UNESCO representatives, including the head of the UNESCO Clearing House for Publications in Paris. It was agreed that the circulation abroad of the journals and the reports of transactions of American engineering societies is a definite influence toward international understanding and should be expanded in the interest of world peace. Since UNESCO's library bulletin has a world-wide circulation, including 8000 libraries, it was arranged that UNESCO will offer through this bulletin a list of these periodicals with subscription rates, and that subscriptions to any of them may be paid in UNESCO coupons. This plan, with other related suggestions, has been submitted to the EJC and approved.

The Engineers Joint Council's International Relations Committee has now set up a Commission on Technical Assistance for the following primary purposes: (1) To establish and maintain liaison with such organizations as the Economic and Social Council and other UN agencies concerned with technical assistance, the United States Department of State (in its administration of "Point IV" and related operations), the Economic Co-Operation Administration, and the Anglo-American Council on Productivity—in order that information or requests for advice or assistance from these organizations may be promptly channeled to the appropriate group or individuals; and (2) to give direction to any other activities that the Engineers Joint Council may decide to undertake in the field of technical assistance. The American Society of Mechanical Engineers also has close contact with the American Management Council, which is the United States member of the International Committee of Scientific Management and is collaborating with the ECA in advancing scientific management in Europe. In these ways the engineering profession in the United States is being brought into a more intimate and, we believe, more potentially effective relationship with the whole program of technical assistance.

These movements toward closer co-operation between UNESCO and the world-wide engineering profession, and between the engineering societies and other agencies concerned with international relations, should encourage practical extension of UNESCO activities along a line of both immediate and long-run need, and enlist the interest of a large group of professionally trained people whose co-ordinated efforts would be helpful in realizing some of the most important of UNESCO's objectives.

SEEKING data on the preparation characteristics of coal in large reserves that might be used in making synthetic-liquid fuels, the Bureau of Mines has tested a number of American coals that may be made more adaptable by mechanical cleaning for hydrogenation, according to a Bureau bulletin.

The bulletin covers washing tests on 13 coal beds previously investigated in small-scale synthetic-fuel research and known to be in some measure adapted to hydrogenation, which is one process for producing synthetic-liquid fuels. Representing deposits in the northern Appalachian region, the eastern interior basin, and the Rocky Mountain area, the coals came from Pennsylvania, Ohio, West Virginia, Kentucky, Indiana, Illinois, Utah, Wyoming, Montana, and North Dakota.

Low-ash coals are desired for hydrogenation and Bureau tests disclosed that only three of the coals tested, the Rock Springs Wyoming coal, the Utah coal, and the West Kentucky No. 6 offer the possibility of obtaining a practical yield of washed product of 2.5 per cent ash content. It was found the selected beds in the central and interior fields could be prepared to an ash content of 4 per cent, but the yield in some cases would be less than half of the raw material.

Although the Bureau tests emphasized ash reduction in the preparation of coals, other characteristics, such as petrographic constituents and sulphur content, also affected in preparatory treatment, were considered. Test data in the publication include ash reduction, difficulties in washing, and the effects of crushing on washability, of washing on petrographic constituents, and of washing on sulphur content. Discussed also are other characteristics of float coal, relation of mining practice to the coal-preparation problem, and economic considerations.

Bulletin 495, "Preparation Characteristics of Some Coals Available for the Synthetic Liquid Fuels Industry," is sold only by the Superintendent of Documents, United States Government Printing Office, Washington 25, D. C., for 50 cents each.

Strategy for the West[1]

By DAVID D. WARREN

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

THE great question that plagues the Western World today is how it can best check the surge of communism, not alone within its own area, but everywhere else as well. After almost six years of trouble with the Soviet Union, there are few people indeed in the West who believe that a lasting agreement can be reached between the Russians and the Western powers through honorable negotiation. To bow to the Russian demands would be to take the road of appeasement, a road the West does not care to travel again. And so, the strategy of the West against communism has been, and is, a strategy of containment, of trying to build "situations of strength" in those weak spots where the experimental thrusts of communism have either made inroads or would be likely to do so.

This strategy of containment—really the brain child of the United States—has not been accepted uncritically everywhere. Some have denounced it on the grounds that containment is too negative a concept, that a more positive program is needed. Others have doubted that the resources of the West are sufficient to adequately carry out the implications of effective containment. Among the spokesmen for containment, Miss Barbara Ward, formerly an editor of the London *Economist*, goes a long way toward answering these charges.

CONTAINMENT A PRACTICAL POLICY FOR WEST

As the title of Miss Ward's book[2] indicates, hers is an ambitious aim—to outline a "Policy for the West." But Miss Ward is not content merely to suggest a course of action for the future. In addition, and very ably, she assesses the policy of the West in the recent past also. In her view, though it is clear that Russia is unalterably hostile to the West, a shooting war is not likely because the dogma of the communists ordains that the logic of history runs in their favor. Still, this does not mean that history ought not to be given helpful shoves as circumstances warrant. For this reason, containment becomes a practicable policy for the West to follow. A good foundation has already been built for such a policy economically via the Marshall Plan and politically and militarily via the North Atlantic Pact.

Yet much more must be done to make Western defenses strong. In the over-all program plotted by Miss Ward, rearmament plays a crucial part. Though the West is stronger than Russia in resources, its military posture is weaker. Fears in the Kremlin of risking all the gains of the revolution will deter the Russians from overt aggression and allow the West the period of time necessary to buttress its military position. More troops should be stationed in Europe, the principle of "balanced collective forces" should be given effect, and the North Atlantic Treaty Organization should be reorganized so as to center responsibility and better delegate authority.

While these measures, if and when enacted, will do much to consolidate the Atlantic Community, there still remains the problem of checking communist advances in other regions of the world. Here Miss Ward is very enlightening. Assessing the prospects of additional Koreas—in other words, aggressions by proxy—Miss Ward concludes that only in Asia can Russia continue to act through satellites without committing its own forces and precipitating a general war. And even in Asia, the obstacles to aggression are great, as recent events in Indo-China and Korea have pointed up.

As necessary as rearmament is, it could have disastrous effects on the domestic economies of the rearming nations. The basis for the margin of superiority enjoyed by the West over the East lies in its productive capacity. Without continued prosperity, the West might well fall victim to communism, which expects, in any depression, to capitalize on the subsequent unrest. Therefore it is imperative that the West develop a balanced program, assuring at one and the same time sufficient armed might and yet not injuring economic health. Miss Ward stresses that it would be unwise for the West to err on the side of modesty in building up its arms.

How to keep the economies of the West not only on an even keel but also to expand them in order to meet the demands of rearmament—this is the crux of the economic dilemma. Miss Ward is no advocate of total mobilization. Containment is a long-range policy and resources must be carefully husbanded. But this requires intelligent planning. Already the West has had much experience with wartime controls. Such extensive controls will not be needed since only a 15–20 per cent allotment of current income for defense is requisite rather than the 50–60 per cent allotment when World War II was in progress. Yet inflation due to the expanded arms program is a real danger and must be counteracted by equating demand with supply. Increased taxation, a defense loan, and credit, wages, and profits controls will soak up excess purchasing power.

GROWTH OF WESTERN PRODUCTION

Even more essential, however, is the actual growth of Western production. According to Miss Ward, the best way of offsetting inflation is to make the arms without sacrificing unduly civilian consumption. Confident that the Western powers—and particularly the United States—have a "built-in" capacity to expand, Miss Ward sets as a figure a 20 per cent rise in production over the next two years. By careful marshaling of economic facts, she makes the attainment of this goal seem credible. Each year since the war, American productivity has advanced 5 per cent. Under the Marshall Plan, European countries have made remarkable strides forward, and the end is not in sight. One fact Miss Ward emphasizes: The battle against inflation can only be won by and through the individual citizen. Particular selfish interests must give way to the common interest. In her words, "Each people will get the defense effort they deserve."

Because the West cannot afford a major depression, a cure for this most deadly of economic ills must be found. More than a mere palliation is demanded; what is needed is immunization. As a student of Keynes, Miss Ward finds her serum in his prescriptions. Basically, demand and investment must be stabilized. Hence the governments of the West must assume certain regulatory functions such as control over general fiscal policy and action to maintain capital investment at a high level, to insure full employment, and to prevent the recurring cycle of

[1] One of a series of reviews of current economic literature affecting engineering, prepared by members of the Department of Economics and Social Science, Massachusetts Institute of Technology, at the request of the Management Division of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Opinions expressed are those of the reviewer.

[2] "Policy for the West," by Barbara Ward, W. W. Norton & Co., Inc., New York, N. Y., 1951. 317 pp., $3.75.

boom and bust. Continued prosperity of the West is at the core of the containment policy. For if that prosperity were to ebb, then the communist tide would begin to flow.

An added drain on Western resources besides rearmament but a prime ingredient in the recipe of containment, in Miss Ward's opinion, is a long-range program of development for backward areas, possibly of 50 years' duration and administered preferably by a centralized international agency rather than on a piecemeal national scale. To satisfy the cravings of those peoples in the underdeveloped regions of the world for better living standards would be to rob communism of much of its appeal, an appeal due more to what it attacks than what it promises.

Since Miss Ward is interested in any steps that will bind the nations of the West together, she gives some attention to the experiments of co-operation and the moves toward unity that have been carried on. Her praise for the Marshall Plan, both in its application and results, is unstinting. Her criticisms of the North Atlantic Treaty Organization are sound. The partners of the Atlantic pact have undertaken to correct some of the weaknesses to which she refers. And in her treatment of the Schuman Plan, she condemns the British Government for its shortsighted refusal to join the proposed organization for the supranational control of Europe's heavy industries. Convinced that the West is advancing functionally toward a closer integration, Miss Ward is all in favor of hastening the growth of a fuller Atlantic alliance based on freer trade and more open markets, and joint planning in the economic, military, and political phases of defense.

Though "Policy for the West" is a compelling argument for the soundness of a containment policy—and Miss Ward does a fine job of demonstrating that the West has the material means to execute such a policy—the question arises whether the people of the West have the stamina and patience that will be required. When one sees, for example, how mercurial the mood of the American people is, reacting to every change in the international scene, shuttling back and forth between the poles of optimism and pessimism, one wonders if they are psychologically prepared to accept the responsibilities that containment policy entails. Miss Ward's book is a persuasive exposition of the reasons why a steady and intelligently applied plan must be followed if containment is to succeed.

New Tasks in Engineering for Small Plants

(*Continued from page 483*)

ficing the quality or appearance of the product or usefulness of a process.

RESEARCH TASKS

A research department is the key to one of the most important functions of a small plant. The small plant can have as effective a research group, proportionately, as a large one, for the results of a research group depend on the ability of the men rather than on the number of men. Their task is breathing new life into the products of the small company to keep it competitive.

The liquid-level indicator manufactured by the author's company was created from an idea discussed during a regular engineering conference. However, the conversation soon became enthusiastic as the possibilities of the idea were unfolded with sketches used to indicate its practicality. The year that followed was replete with models on trial for performance and for appearance until the accepted unit was evolved.

Engineering solutions of such tasks insure the plant's future if they satisfy a demand, and the task is not complete until this demand is met.

Commercial laboratories, college laboratories, and consultants are available for assistance in solving difficult tasks. Their use is economically justified especially when they have the equipment for specialized assignments.

The creation of our impulse steam trap is a good example of the way in which college personnel and a college laboratory were used in aiding the development of a new product. The operating principle is novel and unique and is based on the characteristics of fluid flow through two orifices in series.

SUMMARY

Engineering for the small plant really has no boundaries, and the amount of potential improvement is far beyond the present horizon.

Keen management discernment must be matched by keen engineering insight, and these in turn must be matched with increasing worth inherent in machinery and equipment. The resulting costs and prices must be made always lower rather than always higher, no matter what the difficulties may be to achieve this. But if this apparently impossible objective is achieved, small-plant engineering is bound to take an upturn as never before.

At the mid-point of this century, the new task in engineering lies in making engineering for and in small plants a specific objective. If this is done, this group will represent a market of quite specific needs but also of great magnitude and possibilities for all concerned.

Digital Reader

A NEW electronic device to read test instruments at speeds up to 50,000 readings per second and record the readings on tape or punched cards ready for computation was described recently by Dr. G. W. King of Arthur D. Little, Inc., Cambridge, Mass., before the Association for Computing Machinery meeting at Wayne University, Detroit, Mich.

Called the digital reader, this new instrument is expected to eliminate cumbersome human work involved in recording and computing from strain, pressure, acceleration, and temperature gages, pilot-plant, and other physical and control instruments used in research work in a number of industrial fields. At present it is often necessary to photograph instrument dials at stated intervals; research workers must then laboriously jot down the readings in numerical form and arrange them for computation. Some recording instruments trace out a chart which must be similarly carefully examined and translated in numerical form. The digital reader, when linked to the instruments to be recorded, rapidly converts the electric signals it receives from the instruments directly to convenient binary-digital form for immediate analysis, computation, smoothing, or storage on recording media.

Arthur D. Little, Inc., built its first digital reader to obtain and usefully convert data on infrared spectra. The potential application of the digital reader in many engineering fields was immediately recognized. The original models proved so valuable that the company is now building a number of units as part of a special consulting service in the data-handling field. It is a unit about 20 × 30 × 5 in., operating from 110–125 volts, and easily incorporated in a variety of multiple-instrument reading and recording systems.

BRIEFING THE RECORD

Abstracts and Comments Based on Current Periodicals and Events

Compiled and Edited by J. J. Jaklitsch, Jr.

MATERIAL for these pages is assembled from numerous sources and aims to cover a broad range of subject matter. While few quotation marks are used, passages that are directly quoted are obvious from the context, and credit to original sources is given.

National Inventors Council

A LIST of some of the technical problems affecting national defense, for which the National Inventors Council is seeking solutions or promising ideas which may lead to better solutions, has been released by Charles F. Kettering, Fellow ASME, chairman of the Council.

The National Inventors Council functions in an advisory capacity to the Department of Defense and other departments, agencies, and offices of the Government in evaluating, guiding, and analyzing inventions for the national defense and security. The Council membership comprises outstanding American inventors, scientists, and industrial research men having specialized experience in the development and utilization of inventions, together with the Commissioner of Patents and a representative of each of the three branches of the Armed Services.

The Council was originally created in the fall of 1940 by the Secretary of Commerce with the concurrence of the President. During the war years the Council screened more than 200,000 inventions for the Armed Services. Many of them played an important part in the war—the magnetic mine detector, for example. Since then the Council has continued to function in the Department of Commerce in accordance with the recommendations of the Department of Defense.

Besides acting in an advisory capacity on questions of national security and welfare, the Council functions to (1) encourage the public to submit inventions or inventive ideas of value in the defense and welfare of the nation, (2) acquaint the public with the problems confronting the Armed Services, and (3) refer all potentially valuable ideas to the Department of Defense or other appropriate agencies.

Some of the technical problems from this latest list (List 1950) awaiting solution are as follows:

A need exists for an extra-lightweight, low-ground-pressure, gasoline-operated over-snow vehicle, for use as a prime mover for sleds or men skijoring, and to break trail in snow for men equipped with snowshoes or skis. Gross vehicle weight, combat-loaded, should approximate 1000 lb.

Tests of models previously constructed have indicated limited over-snow mobility, inability to back up on other than hard-packed snow, poor turning characteristics, inability to break a satisfactory trail, and have been satisfactory to only a limited degree as a prime mover.

Machinery for the fabrication and method of welding titanium is necessary. Before the titanium and titanium alloys can be applied widely in the design and production of military equipment certain problems must be solved. For instance, a practicable quantity-production method for welding commercial unalloyed titanium is required. The welding which has been done thus far has been by laboratory methods which are not practicable for use in production. Experience is also lacking in materials and methods of welding high-strength titanium alloys. Likewise, there is lack of experience in casting titanium and its alloys. Except for special equipment which will probably be required for welding and casting, it is probable that standard equipment can be used for other steps in the fabrication of titanium and its alloys.

An automatic coupling joint for connecting panels of fixed-span bridges and treadways of floating bridges should be devised. When used in fixed bridge panels the joint must be capable of transmitting direct stresses in tension or compression and shear. When used in treadways of floating bridges they must serve as moment carrying joints. The joint must lend itself to quick connecting and disconnecting.

The present type of coupling is of the pin-connecting type, requiring heavy pins.

A device that will distribute heat over the human body for exposures at subzero temperatures and moderate winds that will permit individuals to walk about, work with hands, ride or drive in unheated vehicles, or sleep without outer shelter is needed. The device must be independent of any restricting or heavy electric power source. It must have adjustable heat input and must be capable of a minimum of 8 hr operation without refueling. It must permit rapid discarding or ventilation and not hamper agility when greater activity than moderate walking becomes necessary. The device shall not create a fire hazard, "hot spots" that will burn the body, cause toxic fumes, or other human hazard. It must be reasonably lightweight, compatible with normal Arctic clothing and, above all, practical.

How to Obtain Further Information on "Briefing the Record" Items

MATERIAL for this section is abstracted from: (1) technical magazines; (2) news stories and releases of manufacturers, Government agencies, and other institutions; and (3) ASME technical papers not preprinted for meetings. Abstracts of ASME preprints will be found in the "ASME Technical Digest" section.

For the texts from which the abstracts of the "Briefing the Record" section are prepared, the reader is referred to the original sources: i.e. (1) The technical magazine mentioned in the abstract, which is on file in the Engineering Societies Library, 29 West 39th St., New York 18, N. Y., and other libraries. (2) The manufacturer, Government agency, or other institution referred to in the abstract. (3) The Engineering Societies Library for ASME papers not preprinted for meetings. Only the original manuscripts of these papers are available. Photostat copies may be purchased from the Library at usual rates, 40 cents per page.

Another problem is to develop rubber or rubberlike materials which will maintain their functional properties over the temperature range of —65 F to +160 F. The only currently available material which maintains its properties over this temperature range is some type of silicone polymer, but these materials are not suitable in many applications because of their low resistance to abrasion, low tear strength, and low tensile strength. Considerable research has been done on butadiene-type polymers, but no completely satisfactory solution has been obtained. Oil-resistant polymers present an unusually difficult problem in that, in general, the polarity of the molecule, necessary for oil resistance, contributes to poor low-temperature resistance. Completely new applications and ideas on chemical structures which might possess the required properties are needed.

Other problems for which solutions are necessary are as follows: (1) An insect repellant of a type suitable for application by the individual which will effectively repel all insects for a period of 24 hr or more with a single application; (2) a clothlike material possessing ballistic protection which is lightweight, flexible, and not bulky; (3) a means of individual protection from gamma radiation; (4) a method for prolonging the preservation of whole blood; (5) an accurate instrument and technique for barometric leveling; (6) a technique, method, and equipment for the detection of buried explosives; (7) rapid automatic methods of determining the size of smoke particles and the obscuring power of the smoke; and (8) methods for dispersing liquids and solids as a stable aerosol and not decompose the material being dispersed.

Atomic Energy

Zirconium Production

PLANS to encourage wider industrial participation in the manufacture of high-purity zirconium metal for the nuclear-reactor development program have been announced by the Atomic Energy Commission. At the present time, zirconium metal meeting required chemical and physical specifications is being produced largely in Government-owned or controlled facilities, using processes developed by the Bureau of Mines and contractors of the AEC.

The major steps now used in obtaining pure metal from the commercial-grade zirconium tetrachloride are: (1) Separation of hafnium from the crude zirconium tetrachloride; (2) chemical purification of the separated zirconium; (3) calcination and rechlorination of the purified zirconium; (4) reduction of purified tetrachloride using the basic Kroll-type process; and (5) refining of the reduced metal, using the basic deBoer-type process.

Technological information about these unit processes may be made available to private producers who are in a position to supply zirconium metal or the intermediates above on a unit price basis. Classified information can be made available to interested producers following security investigation and clearance.

Manufacturers interested in the AEC zirconium purchase program should write to the Division of Engineering, Atomic Energy Commission, Washington 25, D. C.

Uranium From Phosphates

The Atomic Energy Commission has developed a process whereby uranium in phosphates can be extracted economically in the production of highly refined fertilizer known as triple superphosphate.

In the production of triple superphosphate, phosphoric acid is produced at one stage. In the production chain, between the phosphoric-acid stage and the final stage, it appears to be feasible with the new process to extract uranium from the phosphate by attaching special equipment to the facilities used in the production of the fertilizer.

It has been well known for some time that uranium occurs as a very minor component in phosphate deposits in the Northwest and in Florida. Considerable research work has been done to develop a process whereby uranium can be extracted economically from these very low-grade sources. It is hoped that the new process will open up this new source of uranium. The process is classified and cannot be described.

It was pointed out that in the production of phosphoric acid, sulphuric acid is used. For this reason, sulphuric acid available to industry for the production of fertilizer also assists the Commission's program for extracting uranium from phosphates as a by-product of fertilizer production.

Fission Product Uses

New, constructive, industrial uses for by-products of the atomic-energy program, through the medium of large-scale employment of fission products, are being investigated by the Stanford Research Institute at Stanford, Calif., for the U. S. Atomic Energy Commission.

The immediate objectives of the study are to acquaint industrial concerns with the characteristics of fission products and to obtain the co-operation of industry in developing estimates of their possible utilization.

The atomic by-products known as "fission products" are a highly radioactive mixture of elements produced by the fission or splitting of uranium during the plutonium-production process in nuclear reactors. These radioactive atoms have no usefulness for industrial or explosive power but only for the energetic radiations which they emit. Large quantities of fission products left over from plutonium processing are now stored in a mixture with contaminants in underground tanks at the Hanford, Wash., works.

The scope and objectives of the Stanford Research Institute's fact-finding program are described in detail in a new descriptive booklet entitled, "Industrial Utilization of Fission Products—A Prospectus for Management." The prospectus was prepared by the Institute under contract to the AEC's Division of Reactor Development. The Isotopes Division, which has already made available relatively small amounts of certain fission products, actively assisted in preparing the booklet.

The Institute will distribute the prospectus as part of its current study of the possible market for fission products. The booklet will go to a representative sample of U. S. industry. Dr. J. E. Hobson, director, has announced that the Institute will also have a limited supply of copies available for other interested concerns. They may be obtained by writing to Project 361, Department of Business and Industrial Economics, Stanford Research Institute, Stanford, Calif.

The properties, availability, cost, and possible uses of fission products are the principal subjects covered by the prospectus. In addition, consideration is given to some anticipated problems such as those connected with health and safety, handling and shipping, patent and process protection, and disposal of radioactive wastes.

As a result of this study, industry may be offered an opportunity to tap large-scale low-cost sources of radioactivity. The cost should be substantially lower per unit of radioactivity than presently available sources. For example, the cost per curie of fission products in large quantities is estimated to be

in the range of $^1/_{100}$ to $^1/_{1000}$ of the price of most presently available radioactive materials.

The prospectus points out five of the principal capabilities of fission-product materials that might be of interest to industry: the ability to kill organisms, induce chemical reactions, ionize gases, activate phosphors, and produce rays which can penetrate solids.

The booklet also lists some of the uses these properties suggest, including the sterilization of foods and drugs in containers without heat, production of new or cheaper chemicals, production of improved static eliminators and fluorescent lights, production of new types of luminescent paints and tiles, tracing of pipe-line flows and radiography. Some of these uses are speculative, and others have already been technologically developed through the use of other forms of radioactivity.

New Production Plant

According to the AEC, a new product plant will be built on a four-square-mile site in the Rocky Flats area of Boulder and Jefferson Counties, Colo. Acquisition of land for the new facility, a secret type of operation, will begin immediately by the Missouri River Division of the Corps of Engineers, Department of the Army. The plant will be administered by AEC's Santa Fe Operations Office which is responsible for research, development, production, and testing of atomic weapons. Estimated cost of the facility is $45,000,000.

The Dow Chemical Company, Midland, Mich., will operate the plant and has assisted in establishing production requirements and site criteria. It is expected 1000 persons will be employed when full operations commence.

The Austin Company of Cleveland, Ohio, will prepare the plant design and supervise construction. Austin conducted the site survey and engineering investigation for the AEC.

The new production project will handle radioactive material, as do many other AEC facilities throughout the nation. Protective measures used in the atomic-energy program have been so effective that the Commission's safety record is better than in industry generally.

The operation will have only moderate water, gas, and electric requirements. No further description of the nature of the operation is permitted under security provisions of the Atomic Energy Act.

Brookhaven Reactor Construction

DISCOUNTING the strict security regulations imposed on all highly classified atomic work, the Brookhaven nuclear pile, the nation's newest atomic reactor at Brookhaven National Laboratory, Upton, N. Y., would still have been a challenging construction undertaking. As the first reactor ever built exclusively for research, it is the most versatile and possesses the greatest concentration of instrumentation ever installed in an atomic pile. It can operate at any level up to its 30,000-kw capacity and will allow many different nuclear experiments to proceed simultaneously, each under the most carefully controlled conditions.

Brookhaven's reactor is a giant cube of graphite into which uranium metal is inserted in an exact pattern. Its primary purpose is to produce neutrons for scientific experimentation.

GRAPHITE CUBE

The unusual nature of the engineering and construction program carried out at Brookhaven by The H. K. Ferguson Company, which built the reactor, is indicated by the work that went into the giant cube of graphite where the atomic reaction actually takes place. The cube is composed of 60,000 pieces of graphite, stacked one atop another, like building blocks. There are 2600 different sizes and shapes of graphite, and an individual drawing was prepared for each of the 2600 variations.

Machining graphite to tolerances of thousandths of an inch was unusual in that it was the responsibility of the builder, rather than an outside supplier, to carry it out. For security and other reasons the work was done on the job site, by a Ferguson subcontractor, Liberty Products Company, Farmingdale, L. I., in a former Army gymnasium on the Brookhaven site. The gymnasium was equipped with a complex dust-collecting system to remove graphite dust and provide safe and satisfactory working conditions. Graphite and graphite dust are slippery by nature, and the removal of dust was necessary to prevent accidents.

"Stacking" of graphite in the pile was accomplished with the company's own forces. There is no bonding material between the individual blocks of graphite, and a highly complicated keying system, in which every piece is keyed either once or twice, became a part of the design. The lack of a bonding agent which would have made the process unworkable accounts in part for the close tolerances required to hold the structure together. Both external and internal forces also had to be compensated for in the design of graphite. External forces are strong due to the pressure drop required to provide the large volume of air used to cool the pile. Internal forces arise from the temperature differentials inside the graphite cube during the atomic reaction.

Actual stacking of graphite had to be done under extraordinary conditions as it was necessary to maintain security throughout the operation, and also prevent contamination of graphite. The principal contaminating agent guarded against was borax, an ingredient contained in most laundry soaps. Therefore, personnel stacking graphite were provided each day with a pair of white coveralls and gloves laundered with borax-free soap. They were also furnished basketball shoes to prevent slipping. Gloves were changed about six times daily to avoid accidents likely to result from accumulations of slippery graphite dust from the graphite blocks, some of which were about four feet in length and weighed up to 50 lb.

FIG. 1 WORKMEN INSIDE ATOMIC PILE LOWER CONCRETE BLOCK INTO PLACE

(Grooves in steel plating give some idea of the overlapping method of stacking used. Overlap insures that no straight line radiation will escape from parts of the pile made up of stacked concrete blocks.)

MACHINING OF URANIUM

In the machining of uranium many problems similar to those in fabrication of graphite were encountered. This task was also the responsibility of the builder, but was performed under subcontract by Chapman-Valve Company, Indian Orchard, Mass.

Security provisions for the handling of uranium are probably the strictest of all. The metal was brought to the site under armed guard, and the smallest fraction of a per cent of the material had to be accounted for. Chips and grindings were always under the most careful control.

Uranium, however, is hazardous as well as valuable and must be handled with extreme care to protect the health of workers. It is so chemically active that it will burn under water, and finely divided particles will ignite at room temperature. Uranium is also poisonous and, of course, radioactive. Machining equipment was provided with hoods and exhaust ventilation to protect operators. Contaminated equipment also had to be thoroughly cleaned or disposed of.

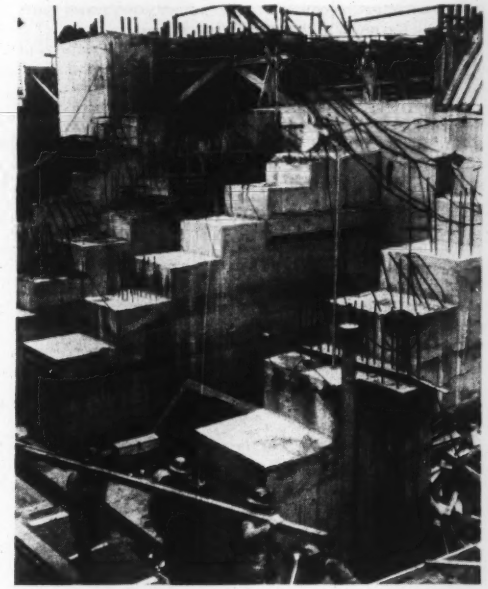


FIG. 2 INTERIOR SHOWING FACE OF ATOMIC PILE

(Three different levels on the face of atomic reactor itself. Materials are inserted into the experimental ports to be subjected to reaction of the pile.)

In addition to its other properties, uranium is extremely abrasive, wearing out cutting tools and inspection equipment rapidly. The metal is also heavy (1150 to 1200 lb per cu ft) and somewhat plastic. Machining and storage were thus planned to involve as little handling as possible. Special cutting compounds were used to keep uranium below the igniting point while being machined.

Despite the difficulties involved, uranium was machined efficiently and to a high degree of finish. The success of the operation, however, required the utmost care and a strict observance of AEC regulations down to the smallest detail.

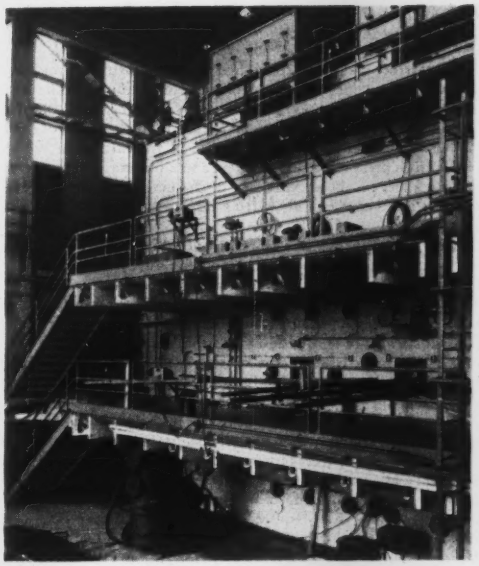


FIG. 3 EXTERIOR SHOWING BUTTRESSES FOR FOUNDATION OF ATOMIC PILE

(Beneath all foundations was a concrete mat 3 ft 9 in. thick, but this mat was increased to 5 ft 9 in. directly beneath the pile.)

SHIELDING

The pile shield which encases the graphite cube on all sides to protect personnel from radiation provided an interesting structural aspect. The shield is constructed of a special classified type of concrete, several feet thick, and steel plate ranging in thickness from 9 to 18 in. The steel plate is used structurally as well as protectively and is said to be one of the largest concentrations of armor plate ever used on a land-based building project for nonmilitary purposes.

The heavy steel plate was obtained from surplus in the Panama Canal Zone, and was fabricated by the New York Naval Shipyard in sections weighing approximately ten tons each. To facilitate erection on the job site, the builders scheduled their work so as to have the pile's permanent 10-ton traveling crane in operation when steel plate was ready to go into place. The girder on which the crane is mounted has a span of 84 ft and weighs 12½ tons.

Many of the steel-plate sections are pierced by holes for control equipment, slots for uranium charges, and openings for experiments. Openings had to be fitted with special plugs that could be inserted when not in use and close tolerances were maintained. The sections were stacked one atop another in the case of wall shielding, and side by side in the base and the top. They were electric-welded in place.

COOLING SYSTEM

To remove the 30,000 kw of heat generated within the pile during the fission process, an extensive cooling system was required. In the fan house adjacent to the reactor building, centrifugal compressors draw 300,000 cfm of air through the pile cooling system. Air speeds vary from 40 mph in the main ducts, two of which are large enough to accommodate a New

York subway train, to hundreds of miles per hour in the small graphite passageways. The five blowers are each driven by a 1500-hp motor at a speed of 3600 rpm.

Every effort was made to adapt existing industrial equipment to the requirements at Brookhaven. For example, in the case of the fans, B. F. Sturtevant Division of Westinghouse Electric Corporation worked closely with Ferguson to adapt one of their models. This fan installation is one of the largest in which such a high pressure ratio is achieved in a one-stage installation of air coolers on the suction side of the fans to reduce the temperature and volume of air, with a resulting reduction in equipment size.

Air is filtered before and after it leaves the pile. Dust is taken out before air goes into the pile, and any dust which may have been picked up inside the pile is removed before it is expelled. The air is finally exhausted through a 320-ft reinforced-concrete stack tapering from 32 ft in diam at the base to 19 ft at the top. A silencer of unique design was built into the ducts and the base of the stack to eliminate noise which would be disturbing in a laboratory setting. Alphons Custodis Chimney Construction Company built the stack.

A secondary cooling system was also installed. It was necessary because temperatures of exhaust gases from the pile are higher than temperatures concrete can stand continuously. The secondary system was therefore developed to prevent impairment of strength and life of concrete in the duct system.

Refrigeration was required for air-conditioning the pile building and control areas, the pile laboratory, and an adjacent "hot" laboratory (see MECHANICAL ENGINEERING, March, 1951, page 228) where radioactive materials are handled. Low humidity is required in these buildings for process control of ambient conditions, and a 500-ton system was installed. Air conditioning was installed only in laboratory working areas which require maintenance of uniform temperature and humidity conditions for operation of delicate instruments and control of experiments.

FOUNDATION

The foundation problems, for which Prof. D. M. Burmister of Columbia University served as consultant, are especially interesting for two reasons. First, the nature of the pile and the method of assembling graphite required prediction of settlement and tilting of the foundation within close tolerances. Second, the weight of the pile is so great that it caused stresses of more than one ton per square foot at a depth of 100 ft below the footing. The total weight of the pile—about 40 million lb including the foundation—produces a soil pressure of 6500 lb per sq ft under the footing.

Total settlement, as well as differential settlement or tilting, had to be predicted and compensated for in advance. Prior to the start of detailed design, borings and load tests were made to determine the elastic properties and the load-settlement characteristics of the subsoil after the overburden was removed. (The foundation extends 35 ft below the surface.) The predicted total settlement was of the order of 2 in., and actual total settlement was $1^1/_2$ in. when measurements could no longer be made. This was compensated for at the elevation where the base for the actual pile structure was laid by correcting for tilting and by building the base higher by the amount of the additional settlement to be expected.

The total settlement in sand takes place during construction when the loading of the base is complete; therefore, the predicted and actual settlement were within the desired tolerances. Since the base was sand, there was no plastic flow of the soil to contend with.

The entire structure was also designed to withstand earthquake shock.

Jet-Engine Developments

AIR Force and industry power-plant designers are finding that present gas-turbine engines, especially those of the centrifugal type, are continually becoming obsolescent, according to the CADO *Technical Data Digest*, April, 1951. Much greater power is needed for present and future supersonic aircraft, it is pointed out.

Directly tying in with this need for greater power is the problem of adding more compressor and turbine stages. While this is being done, the increase in engine bulk and frontal area must be kept to a minimum.

Because centrifugal-type jet engines have great bulk and relatively large diameters, they are not considered ideal for structural changes and installations. Axial-type engines, on the other hand, can be expanded axialwise to accommodate more compressor stages, producing higher compression ratios without adding too much to the bulk or frontal area.

Until last year, jet engines of both types having ratings up to 5000 or 6000 lb of thrust were quite satisfactory for military and commercial needs in the subsonic field. But when the most powerful USAF interceptor in use today, the North American F-86, met the Soviet MIG-15 in Korea, it was found, as Air Force Chief of Staff Hoyt S. Vandenberg put it, that "their MIG-15 is, for speed, in the same class with our fastest standard interceptor." See "Jet Fighters," page 505.

It is for that reason that the United States and its allies, especially Britain and Canada, are stepping up their research to develop more powerful jet engines. Most of the engines are still classified, but details on some have been released.

This country now has three gas turbines, all of them either undergoing service tests or in production, in the 5500 to 6500-lb-thrust category. They include the Allison J-33 (400-D12) rated at 6350 lb of thrust (in the service test stage), the Pratt & Whitney J-48 rated at 6250 lb of thrust, and the General Electric J-47 rated at 5500 lb.

Canada is flight-testing the Avro Orenda, officially labeled in the 6000-lb thrust class.

Britain also has three jets in the same power category. They include the de Haviland Ghost (5500), the Rolls-Royce Nene 3 (5500), and the Rolls-Royce Tay (6250), on which America's J-48 is based. All three are in mass production.

Five of these engines are of the centrifugal type, and there is little possibility that their thrust can be appreciably increased. The J-47 and Avro Orenda, however, are axial-type engines, and can possibly be extended.

In the 6500 to 8000-lb thrust range are the Westinghouse J-40 (6500), now undergoing service tests, and a modified J-47 rated at 6500 lb, also in the service-test stage. Britain's Rolls-Royce Avon (7000) is in production, while their Armstrong Siddeley Sapphire (7200) is undergoing flight tests. Curtiss-Wright will mass-produce the Sapphire in the United States with a J-65 designation.

Also not to be overlooked as possible source of power for supersonic craft are improved rocket engines and, quite probably, an atomic power plant.

The latter moved one step closer to reality late in February when the Air Force and the Atomic Energy Commission jointly announced that "the first phase in the program to produce an atomic plane has been completed." Fairchild Engine and Airplane Corporation, which had been prime contractor for four years on the Nuclear Energy for the Propulsion of Aircraft (NEPA) project, was commended for its intensive research along with nine other aircraft and engineering companies.

The General Electric jet-engine plant at Lockland, Ohio, will continue work on the atomic engine.

Jet Fighters

THE latest Russian jet fighter plane in the Korean theater can step away from any United States plane now engaging it in combat, reports from U. S. pilots indicate, according to an address given by Dr. John T. Retalliata on the comparative performance of Russian, American, and British jets in Korea, before a luncheon meeting at the recent Midwest Power Conference held in Chicago, Ill. Dr. Retalliata is a member of ASME, vice-president of Region VI of ASME, and vice-president and dean of engineering at Illinois Institute of Technology. The Russian MIG-15 jet, he said, has shown sudden bursts of speed which have enabled it to outdistance pursuing American jets. Some reports indicate the MIG-15 is capable of attaining supersonic speeds.

Detailed design information on the MIG is naturally not readily available, but from observations of the plane while in flight it is believed that its superior acceleration is due to an afterburner, rocket assist, or liquid injection, Dr. Retalliata revealed.

An afterburner, installed in the tail pipe to the rear of the main jet engine, is a device for augmenting the thrust or propelling force on the plane by burning additional fuel in the jet gases and thereby increasing their rearward discharge velocity. Thrust augmentation by rocket assist is accomplished by setting off, when desired by the pilot, rockets (probably located in the tail pipe on the MIG) so as to add their thrust to that produced by the main jet engine. Several American planes are equipped with afterburners and rocket-assist features. Liquid injection involves the introduction of liquids into the gas-turbine jet-engine cycle for purposes of increasing the propulsive thrust normally produced.

In addition to favorable acceleration and speed characteristics, the MIG has demonstrated a rapid rate of climb and much stamina, he reported. On numerous occasions it has been badly damaged by United States fighters but it has still managed to return to its base even though crippled. The prevailing aspect of not getting shot down in United Nations territory has perpetuated the mystery as to who is flying the MIG's. The further reluctance to become involved in an encounter except in their own area has promoted the belief that the MIG pilots are not Chinese, but rather Russians who are thus avoiding the possibility of being detected in such a capacity.

It is believed that the MIG-15 has a centrifugal-type jet power plant similar to the British Nene or Derwent engines, with a rated thrust of approximately 5500 lb. This engine type, possibly modified by Russian designer Chelomey, is a logical assumption since the British several years ago sold the Russians a quantity of their latest jet engines.

Notwithstanding its various superior qualities, the Russian MIG has given a very poor account of itself in combat, principally because of inferior pilots and a lack of latest gunnery improvements, according to Dr. Retalliata. In addition to superbly trained pilots, U. S. jet planes have electronic computing sights giving extreme firing accuracy.

The most advanced type of American jet plane engaged in action in Korea is the F-86 Sabre, which is recognized as the world's fastest operational airplane. Its top speed of 710 mph is considered greater than that of the MIG-15, and it probably outperforms the MIG except for acceleration. It is difficult to obtain an accurate evaluation of the MIG-15 as compared with the F-86, however, because of the tendency of the MIG pilots to avoid combat, and also their demonstrated lack of skill. In an encounter involving pilots of equal ability it is believed that the F-86 would show a margin of superiority, he said.

Dr. Retalliata also indicated that latest American jet designs possess potentialities for performance even more outstanding than anything yet revealed in Korea. The presently highest-powered jet engine developed in this country is reported to have a static dry-thrust rating of 10,000 lb. This is about double the thrust of any jet engine being used in Korea. It surpasses the British Sapphire jet engine, whose 7200-lb thrust was reputed to be the highest formerly available. Other high-capacity engines are also being developed, and the coveted 10,000-lb thrust goal will probably be exceeded soon by several engines. In the not-too-distant future it is reasonable to expect that fighter planes will have attained classification in the 1000-mph category.

It should be constantly borne in mind, he said, that United States survival may depend upon the adequacy of air power. It should also be forever remembered that Russia is striving just as desperately to achieve superior weapons, and has the talent and facilities to be successful. Do not underestimate her capabilities, Dr. Retalliata warned.

Helicopters

Great Britain

BRITISH designers are working on plans for three new large two-engined helicopters for passenger-carrying—one of them powered by turboprop engines.

The first of the piston-engined helicopters, the 10–12-seat Bristol 173, will soon be flying. It has two Alvis Leonides 550-hp engines and can fly on one engine. Design plans for the other are being drawn up by the Cierva Autogiro Company, who have now been taken over by Saunders-Roe. Their plans are for a three-rotor machine to carry 24–32 passengers at about 116 mph.

The jet helicopter is under development by Faireys. Called the Rododyne, it will have two gas-turbine engines outboard of the cabin, and air from these engines will be "tapped" to the rotor-blade tips to turn them. The blade tips will also be fitted with small separate jet units for giving a powerful thrust for take-off and landing. The Rotodyne is designed to carry 23 passengers at a cruising speed of 135 mph, but a considerable amount of advanced development work will be necessary before it reaches the flying stage.

These large helicopters will eventually take over from the small single-engined helicopters which are now operating experimental services. The British European Airways Helicopter Unit, which ran the world's first night-mail service and the first scheduled passenger service, uses the small Westland S-51 helicopter. Proving flights for a new summer service between London and Birmingham have already begun.

The prospect of widespread helicopter services in Britain has been investigated by a Committee set up by the Ministry of Civil Aviation. In its report the Committee describes the helicopter of the future: It will have two engines (and be able to fly on one of them), and carry more than 20 passengers. Its rotor blades will be able to fold up so that the helicopter can be "parked" in a small space, and it may have a "revolutionary" landing gear. A helicopter of this design ought to be ready for operation in 1958.

U. S. Navy

Contracts for the development and construction of two experimental transport helicopters have been awarded by the U. S. Navy.

Designed to meet Marine Corps requirements for operation from all types of naval vessels, the helicopters will be built by

the Sikorsky Aircraft Division, United Aircraft Corporation, Bridgeport, Conn., and the McDonnell Aircraft Corporation, St. Louis, Mo.

Both are designed to carry pilot, copilot, passengers, and litters or cargo.

The type to be constructed by the Sikorsky Aircraft Division will have a single five-bladed main rotor and an antitorque tail rotor typical of previous Sikorsky designs. All rotors will be foldable for ease of storage.

A single, three-bladed, jet-propelled main-rotor type, also foldable for ease of storage, will be constructed by McDonnell.

Extruded Steel Propellers

IN co-operation with the U. S. Air Force, the Propeller Division of Curtiss-Wright Corporation, Caldwell, N. J., has developed a new mass-production method of hot-extruding one-piece hollow-steel propeller blades for high-speed combat and commercial aircraft.

The new extrusion process, it is reported, makes possible great savings in strategic materials, skilled manpower, costly machining operations, floor space required for manufacturing, and tools—all factors which will be of prime importance in the event of general mobilization requiring rapid increase of facilities and productive capacity.

A marked increase in blade quality and strength-weight ratio is said to accompany the process. The tough homogeneous structure of the extruded steel provides greater resistance to the more severe stresses to which propellers for higher-horsepower piston and turboprop engines, now in production or being designed, will be subjected.

Production for U. S. Air Force aircraft already has been initiated and plans are being made to supplement welded types now being manufactured with extruded blades as rapidly as facilities become available.

While extrusion—the art of shaping metal in a continuous form by forcing it through a die—has been practiced by industry for over a quarter of a century, use of the basic process has been confined principally to the production of pipe, tubes, bars, and other simplified forms except in the lighter and softer

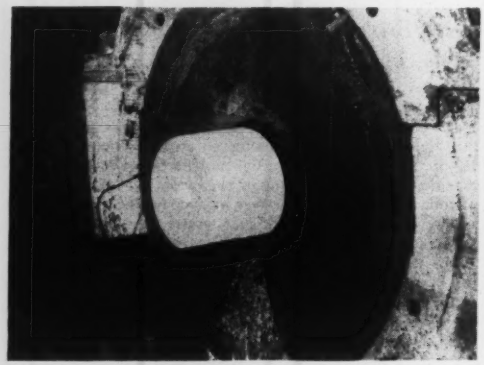


FIG. 4 WHITE-HOT STEEL BILLET BEING INSERTED IN THE DIE CONTAINER OF THE EXTRUSION PRESS FOR FIRST OPERATION WHICH FORMS SHANK OF FINISHED PROPELLER BLADE

FIG. 5 REHEATED AFTER FIRST EXTRUSION, PARTIALLY FORMED BILLET IS RETURNED TO THE PRESS FOR SECOND OPERATION OF PROCESS WHICH EXPANDS AND TAPERS THE SHANK SECTION

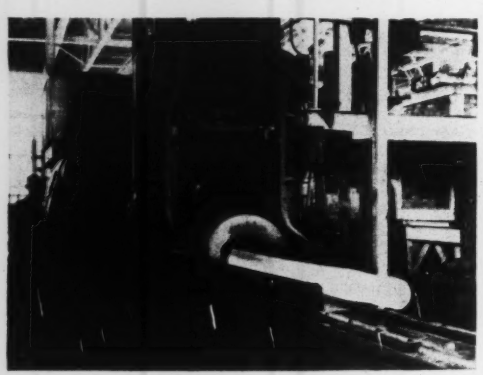


FIG. 6 SHANK-END FIRST, A WHITE-HOT PROPELLER-BLADE TUBE EMERGES FROM THE PRESS ON THE THIRD AND FINAL OPERATION OF CURTISS-WRIGHT'S NEW EXTRUSION PROCESS

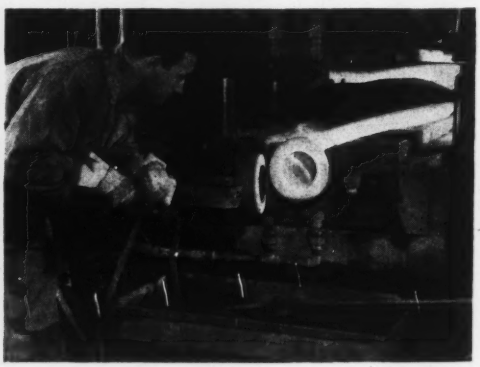


FIG. 7 EXTRUDED STEEL TUBE IS TRANSFORMED INTO A PROPELLER BLADE BY HEATING AND FLATTENING AND FORMING AGAINST A DIE WHICH GIVES IT PROPER TWIST AND SHAPE

metals. When the Air Force–Curtiss-Wright research program was inaugurated, no recorded data were available on the hot-extrusion of steel in anything approaching the complex shapes and tapered thickness required in propeller-blade manufacture.

From this standing start, Curtiss-Wright and Air Force technicians, with the aid of the metalworking industry, perfected in less than two years, the technique of squeezing a white-hot 400-lb chrome-nickel-molybdenum steel billet through appropriate dies with a 5500-ton press to produce a 200-lb 10-ft propeller-blade tube. This process, accomplished in three stages, contrasts with present time-consuming methods of welding together, brazing, and forming two specially processed flat plates, weighing 750 lb before machining, to produce the same-sized blade.

The rough propeller blade comes from the extrusion press in the form of a tapered-wall, seamless, round tube with "ears" or ridges running from the shank to the tip. In subsequent operations, the tube is flattened and shaped and the ears become the solid leading and trailing edges of the blade. Finishing operations are similar to those now used.

Among other items able to be produced by extrusion are landing-gear struts, helicopter masts, helicopter or aircraft drive shafts, helicopter main-rotor-blade spars, gun barrels, tank parts, ship parts, and members for prefabricated structures such as bridges and towers.

Harder Stainless Steel

THE presence of magnetism in a fractured piece of stainless steel has led to a new process whereby this metal can be made some 100 per cent harder than has been possible by conventional metalworking procedures, according to the *Westinghouse Engineer* for March, 1951. This hardness increase, achieved by working at subzero temperatures (down to minus 300 F) make stainless steel, never noted for its hardness, a more versatile metal.

During the course of some fundamental investigations of cast stainless steels of Crane Company laboratories, impact tests were conducted at the temperature of liquid nitrogen (about —300 F). After the tests had been completed, one of the samples, which had by then returned to room temperature, exhibited a strong magnetic effect near the fracture. Other samples broken at room temperature showed none of this magnetism. Subsequent tests showed that temperature alone was not a factor. Apparently the increase in permeability had been caused by a combination of the severe plastic deformation —caused by the impact tests—and the low temperature.

It is well known that when steel is either heated or cooled certain changes in its crystal structure may take place. In cooling to subzero temperatures, stainless steel can be made to change from the gamma to the alpha state, and this transformation brings about various changes in physical characteristics. Magnetic permeability is but one property affected.

To research engineers this was a clue that other improved properties could also be expected by working the metal at low temperatures. A few tests with the broken impact samples were made by Dr. Ziegler of Crane Company and confirmed this supposition—adjacent to the fracture, hardness had increased over that in the "as-cast" condition by some two to three times—to about 400 V.P.N. (Vickers Pyramid Number, standard hardness test).

This rather startling discovery was the basis for intensive cooperative studies by Dr. Ziegler and P. H. Brace of Westinghouse Research Laboratories whose engineers explored the effects of rolling and drawing at subzero temperature. Several combinations of preparatory heat-treatment, subzero working, and subsequent high-temperature aging were tried. Some of the best results were obtained by a short period of heat-treatment at about 2100 F; quenching in water; cooling to about —300 F; rolling the metal while at that temperature from $\frac{1}{4}$ in. down to $\frac{1}{16}$ in.; and then aging for several hours at about 750 F. The results were better than obtainable by low-temperature rolling alone, by preparatory heat-treatment alone, or by any combination of these processes. Significantly, the highest hardness and strength values were obtained in those specimens rolled at the lowest temperature. Tensile strength, yield stress, and hardness were all increased markedly by this process as compared to conventional rolling. Of particular interest was the increase in proportional limit, which proved to be more than double that obtained by rolling at room temperature. Torsional yield stress and fatigue strength were also increased by about one half. The process is called Zerolling.

One sample tested showed an even more remarkable characteristic. Austenitic stainless steels worked by conventional methods have a very low wear resistance, as compared to the best wear-resistant metals, such as certain of the cobalt-chromium-base alloys frequently used because of their excellent resistance to wear under sliding friction. Yet one of the specially processed stainless-steel specimens, differing slightly in composition from the others, showed a wear performance equal to or better than the best wear-resistant metal combinations. Possibly these unusual results can be reproduced consistently.

Fused Stabilized Zirconia

AN important new refractory product, fused stabilized zirconia, was announced recently by Norton Company of Worcester, Mass. Because the molded shapes can be used at temperatures as high as 4600 F, Norton fused stabilized zirconia promises to open up an entirely new processing era at ultrahigh temperatures.

This special refractory combines the important qualities of exceptionally high melting point, exceptionally low thermal conductivity, and great chemical stability. Also, stabilized zirconia is said to be an excellent conductor of electricity at elevated temperatures although it is a poor conductor at low temperatures. The use of stabilized zirconia makes possible lower heat loss with consequent reduced operating cost plus the important advantage of operating at much higher temperatures. Its chemical stability and inertness make it suitable for both oxidizing and reducing conditions.

All of the uses to which this product can be put are not yet known. However, the following uses have already proved important:

1 Furnace linings for gas synthesis in either oxidizing or reducing atmospheres and for furnaces to melt steel, refractory alloys, platinum, etc. It is also being used to line ceramic kilns to operate at temperatures above 3000 F.

2 Kiln furniture in the form of setter plates being used for firing barium titanates in the manufacture of capacitors for the television industry.

3 Electric heating elements in both ultrahigh-frequency induction furnaces and in resistance furnaces.

4 Thermal insulation in high-frequency reduction or resistor-wound furnaces.

5 Furnace parts in nitrogen fixation at temperatures up to 4200 F.

6 Reaction engine parts as liners for jets and rockets.

Zirconia has physical properties that have long attracted

attention. Its exceptionally high melting point of 4900 F is about 1300 deg higher than aluminum oxide.

However, there has been negligible use of zirconia in refractory shapes until recently because of an inversion in its crystal structure, accompanied by a substantial change in volume, that occurs in the neighborhood of 1800 F. It was not until recently that research proved that zirconia could be stabilized so that refractory shapes would not change in either structure or volume even at elevated temperatures.

Two Norton research men developed and patented a special electric-arc-furnace process in which low-purity zirconia ores are purified and stabilized during a single furnace fusion. The process covered by this patent has a decided advantage over other methods of manufacture in which the purification and stabilization require two or more steps.

The zirconia ore used by Norton is zircon sand which is found in plentiful supply as a natural mineral in Australian and Florida beach sands.

Until recent years, refractory products were always held together with an auxiliary bond which usually contained clay. This developed a glass bonding phase during the firing of the refractory in the kiln. Such products always have the shortcomings of the glass bond which softens and becomes weak at high temperatures. Today the company produces "pure-oxide" refractories, of which zirconia is the latest example, which do not depend upon the development of a glass bonding phase. They have no added bond and therefore the molded shapes which are self-bonding can be used at temperatures almost as high as the melting point of the raw material.

It is reported that stabilized zirconia will stand the highest temperature of any commercial oxide refractory available today. It extends operating conditions beyond those previously available and is already making possible for industry new chemical reactions and new products on a commercial scale hitherto impossible.

Silicones

SILICONES are a chemical combination of both inorganic and organic materials, and they possess some of the properties and characteristics of both classes of materials, writes I. W. Hutcheson of the Dow Corning Corporation, in *The Tool Engineer*, March, 1951. For example, silicones are resistant to temperature extremes, chemicals, and moisture. They possess good dielectric properties and may be produced in several different physical forms.

There are now about 80 different silicones commercially available, divided into the following four groups: (1) Fluids and oils; (2) compounds and greases; (3) resins and varnishes; and (4) elastomeric materials (silicone rubber).

As fluids or oils, the first large-volume peacetime use for silicones was in the rubber industry as mold release agents or die lubricants. This is especially important in the tire industry. Silicone release agents are also used as lubricants for die-casting zinc and aluminum. In addition to their release property, silicone fluids also possess the ability to maintain a relatively constant viscosity over a wide range of temperatures. This makes them suitable as hydraulic oils and damping media.

Silicone fluids or oils are also used as bearing lubricants. Accelerated breakdown tests indicated that one application of silicone fluid would provide adequate lubrication for at least four to five years, in the bearings of an oil-furnace fan motor. Lifetime field tests confirmed these results.

Silicone fluids are also used to prevent foaming in petroleum oils. This is a serious problem with both straight cutting oils and with the soluble oils frequently used to lubricate and cool high-speed drills and other cutting tools. Most remarkable about this application is the concentration required; only one part of silicone fluid per million parts of oil is sufficient.

Chief among the applications for the silicone compounds are those resulting from the release properties characteristic of these semisolid materials. These inert compounds are used wherever a release agent is required in the rubber, plastics, and plywood industries.

Good lubricity combined with stability at high temperatures and excellent oxidation resistance are the reasons why silicone greases are considered essential in a wide variety of industrial applications. These inert greases are used to lubricate ball bearings operating at high and low temperatures and such low-speed high-temperature equipment as conveyer bearings, oven machinery, and pumps handling hot liquids.

With the development of glass fabrics, the resin and varnish silicone binders became the inherent limitation, of how hot an electric motor can run—disregarding the metal portion.

Silicone resins and varnishes possess the heat stability necessary for full utilization of glass electrical insulating components.

In addition to increased service life of motors, there are other advantages to be gained by a more heat-stable electrical insulation such as silicone insulation. Design engineers may now build smaller and more compact motors. The motors may heat up without injury to the silicone insulation because it easily withstands operating temperatures of 200 to 250 C.

Other silicone resins are used as vehicles for high-temperature paints and enamels. Paint deteriorates rapidly on hot surfaces such as smokestacks, mufflers, and exhaust cylinders. Also, white enamels do not stay white long; they slowly yellow with age. Silicone resins, with their inherent stability to heat and oxidation, have solved many such troublesome problems. These resins require baking to develop their properties, hence silicone paints are not yet available for exteriors of dwellings but should become available in the future.

Silicone rubber is able to withstand temperatures of 500 F and yet remain flexible at temperatures of minus 100 F.

The material is available in two forms, one a thick heavy paste, the other a stock or "crepe." The pastes are used to coat glass cloth and as calking and potting compounds. The stocks or crepes can be molded, extruded, laminated, calendered, or sheeted to form gaskets, seals, diaphragms, hose, and mechanical parts.

To meet the severe service in airplanes, silicone rubber is used to seal the heating and anti-icing systems, bomb bays, limit switches, and rocker-arm housings.

Industry has many applications which require gaskets and seals to remain flexible at high temperature. Quite often it is necessary to make elaborate design changes to put the gasket location away from the source of heat. Silicone rubber provides a flexible gasket which makes possible simpler and less expensive designs.

Metal Adhesives

Glass-to-Metal Solder

ENGINEERS of the General Electric Company have developed a process of soldering glass to metal which, it is reported, makes a bond stronger than the glass itself.

The method, which can also be used to solder metal to ceramics and carbon, was originated by scientists of the G-E Research Laboratory, and is currently being tested for industrial applications by the company's General Engineering Laboratory.

The glass and metal areas to be soldered are painted with a thin layer of titanium hydride, and solder is placed upon both painted areas. The parts are placed together and then heated under a vacuum.

When the temperature reaches about 900 F, the titanium hydride decomposes. This causes the solder, which has already become molten, to adhere to the titanium-painted areas of both glass and metal. A strong tight bond is formed upon cooling.

By using soft metal solders, it is possible to subject this glass-to-metal seal to rapid temperature changes without danger of cracking, despite the wide difference in temperature expansions between glass and metal. This is possible because the differences in movement are absorbed by the solder.

The new technique is now in use in aircraft ignition systems and laboratory investigations have suggested possible applications in the manufacture of transformers, capacitors, and electric motors. These possibilities are now under consideration, according to laboratory engineers.

Rubber Cement

A rubber cement called Plastilock, developed by B. F. Goodrich Company, Akron, Ohio, since the end of World War II, is said to be capable of sticking metal to metal with a bond stronger than rivets or nuts and bolts can make.

The new rubber cement was first used to bond brake lining to brake shoes in motor vehicles. Latest model United States fighting aircraft now have brake linings bonded with the new adhesive. Since Plastilock eliminates rivets in brake-lining applications, service life of the lining is automatically increased about 75 per cent, it is reported.

One manufacturer uses the adhesive to make a stronger more serviceable gasoline tank by cementing the metal sections together. Nuts, bolts, and gaskets formerly used are no longer needed. Other advantages met in this case include speed of application, elimination of processes, and the perfect seal Plastilock makes against petroleum products.

Rubberized Paint

A REVOLUTIONARY interior paint that has unusual decorative qualities combined with the rugged durability and washability of an enamel, and yet possessing the appearance and usefulness of a flat wall paint, was introduced by the Pittsburgh Plate Glass Company, Pittsburgh, Pa.

The new product, to be known as Wallhide Rubberized Satin Finish, is described as having properties never before obtainable in a wall coating. It has rubberlike characteristics with a distinctive sheen that is low enough to make it suitable for use in any room of the home, according to a company spokesman.

One advantage of the new finish is that it requires no special primer because it acts as its own primer. Exceptional ease of application with no brush pull enables any one to do an excellent paint job with this ready-to-use product. It may be applied by brush, spray, or roller coater on any interior wall or ceiling surface including new or old plaster, paint, wallpaper, wallboard, brick, concrete, cinder block, wood, or primed metal.

Grease, crayon, lipstick, finger smears, and ink spots may be easily removed from the painted surface because the rubberlike film prevents such materials from penetrating the surface, the company stated.

It was also pointed out that the new finish will fill a special need for hotels, hospitals, and other institutions where quick drying of paints is an important factor. In hotels, for instance, rooms may be repainted and ready for occupancy within a short time because the rubberized paint has no objectionable odor either during or after application.

The finish dries in one hour to a smooth velvetlike sheen without apparent brush or lap marks. Curtains and pictures may be hung shortly thereafter and the room is ready for occupancy. If a second coat is desired, it may be applied in four hours.

Unlike ordinary paints, it was explained, the rubberized film does not shine up when washed in local areas. Neither does it crack nor chip because the film remains flexible. It resists wear like a fine enamel. After drying several weeks, the painted surface may even be scrubbed without damage to the sheen or color.

Super Vacuum Bottle

A VACUUM bottle that can hold the world's coldest liquid 15 times longer than the best container previously available has been developed at the Westinghouse Research Laboratories, Pittsburgh, Pa. See frontispiece, page 466, of this issue.

Dr. Aaron Wexler, head of Westinghouse low-temperature studies, revealed perfection of a copper vacuum bottle that will hold four gallons of liquid helium—used by scientists in studies of materials at subzero temperatures—at a temperature of only eight degrees above absolute zero (—459.8 F) for 100 days.

Dr. Wexler announced the new device at a Symposium on Low Temperature Physics held at the U. S. Bureau of Standards, Washington, D. C. He collaborated in its design and construction with Howard S. Jacket of the Hofman Laboratories, Inc., Newark, N. J.

The new vacuum bottle consists of two highly polished copper spheres—one inside the other—about a foot in diameter. Most of the air is evacuated from the area between the two spheres. The bottle is immersed in a tank of liquid nitrogen at a temperature of —300 F to minimize heat losses.

Heart of the new device is contained in the long narrow neck tube through which the liquid helium is poured. Since practically all of the heat transmitted into the interior of the bottle is conducted down the surface of the neck tube, the Westinghouse scientist designed the neck to cut these losses to a mimmum. This was done by making the tube slightly more than a half-inch in diameter, increasing its length, and using thin-walled metal. Through such design, Dr. Wexler was able to reduce the heat inflow by 90 per cent.

What happens is that the supercold helium vapors coming from the container serve to refrigerate the neck tube. This essentially neutralizes the transmitted outside heat and thereby narrows the temperature gap between the tube and the helium. By improvements in the design of the tube, the scientist predicted, even more efficient containers could be developed.

When liquid helium evaporates, it builds up pressures in the container, Dr. Wexler explained. If a cork were put on the bottle, the pressures would go high enough to cause an explosion. Therefore a tiny opening at the top of the container was provided that acts as a safety valve.

According to Dr. Wexler, the new vacuum bottle answers the need for a long-time storage container for liquid helium and may help bring about a radical change in present shipping methods for such refrigerants. Because liquid helium evaporates rapidly—840 times faster than water does at the boiling point—it has been necessary to ship it as a gas and then liquefy it at the point of use. This has required the use of heavy steel con-

tainers and very high pressures to keep the volume of the gas down to a minimum.

With the new vacuum bottle, he said, it may be possible to ship liquid helium in thin-walled containers at ordinary atmospheric pressure, thus effecting a saving in both space and materials.

Utiliscope

TO obtain every possible ton of steel production for the defense program with diminishing available manpower, a Utiliscope (wired television), made by the Diamond Power Specialty Corporation, Lancaster, Ohio, is playing an increasingly important part.

For example, at the Babcock & Wilcox Tube Company, Beaver Falls, Pa., the Utiliscope is being used to save manpower, promote safety and control quality in the continuous casting of steel billets.

The pouring operation is very critical. To get good sound billets, without spongy spots or air inclusion, the mold must always be kept full to a certain exact level. Formerly, it was necessary to station a man directly at the mold top to watch the pouring, ready to signal the operator 50 ft away. There was always the possibility of a misunderstanding, the hazard was high, and the discomfort from radiant heat quickly became unbearable.

Now, as shown in Fig. 8, a Utiliscope camera with a long-focus lens is suspended above the molten metal surface in the mold. It transmits an exact instantaneous continuous picture of the molten-metal level to the viewing screen which is placed in a control panel. Here the operator watches the pouring at close range, and in safety and comfort.

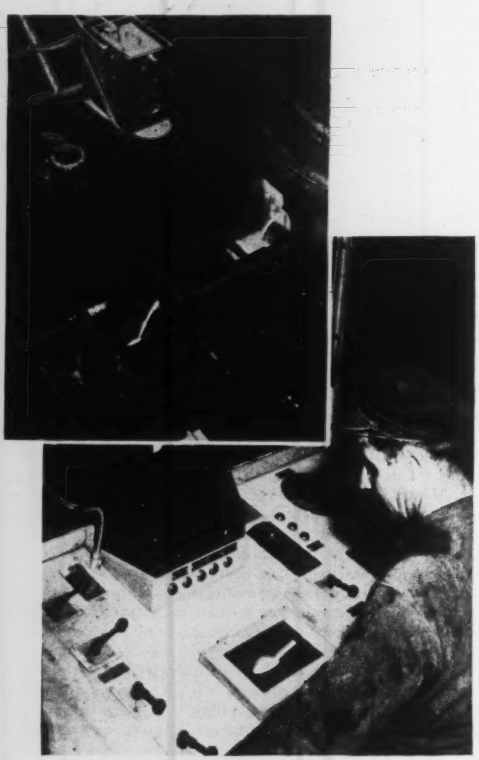


FIG. 8 WIRED TELEVISION WATCHES POURING OF MOLTEN STEEL

(Utiliscope camera, shown in upper left of upper picture, is focused down on stream of molten steel as it pours into mold for continuous casting of steel billets. Lower picture shows operator watching the process on screen so that he can closely control this critical pouring operation. Camera and viewing screen are connected by coaxial cable.)

Relaxometer

AN apparatus designed to measure the extent of relaxation of nonmetallic gasket materials under conditions by which variables such as heating and cooling cycles, flange pressure, retorquing, humidity, etc., which ordinarily occur under field conditions, may be controlled, was described by R. G. Farnam, president of the F. O. Farnam Company, Chicago, Ill., at a Rubber and Plastics Technical Session during the 1950 ASME Annual Meeting.

Named the Relaxometer, the instrument was designed and built by the Cole Electric Company, Park Ridge, Ill. The Relaxometer, see Fig. 9, was designed around a sealed hydraulic system and a Bourdon-tube-type gage.

A thin disklike chamber (G) is provided between two rigid metal pieces (C and H). The top block (C) and the piston (H) are connected together with a flexible metal bellows (F) brazed in place. The bottom and top blocks (K and C) are aligned with dowel pins (not shown) which allow the top block (C) to move up and down freely.

The hydraulic system after evacuation is filled with a fluid of high boiling point and low thermal-expansion characteristics.

A specimen of gasket material (I) is placed under the piston (H) and pressure is applied on the top block (C) by means of a jackscrew (O). The pressure on the top block (C) is exerted through the hydraulic system and the piston against the gasket material and is indicated by the gage (A).

A slight fluid displacement takes place during compression due to fluid traveling from the hydraulic chamber (G) to the Bourdon tube. Hence the thickness of the hydraulic chamber has been slightly reduced. With the piston in direct contact with the bottom block (K), the thickness of the hydraulic chamber is reduced 0.0003 in. at 10,000 psi pressure from what it was at 0 pressure. This slight reduction in the thickness of the hydraulic chamber is accomplished by providing a large piston area in relation to the volume of fluid displaced. It is believed that an error of this magnitude is insignificant in respect to the commercial variation in samples of the same materials; however, it can be compensated for completely. A micrometer screw (E) is mounted in communication with the fluid in the hydraulic chamber (G). This micrometer is sealed with a rubber O-ring. For tests requiring the ultimate in accuracy, the micrometer can be used to compensate for the hydraulic-chamber thickness error. For each 1000 psi difference in gage reading, the hydraulic-chamber thickness change is 30×10^{-6} in. The micrometer can be used to transfer fluid back into the hydraulic chamber (G) to restore it to exactly the same thickness it was under zero load. This compensation amounts to 0.0059 in. on the micrometer used in the instrument per 1000 psi pressure.

For tests requiring temperature cycling, electric heating elements (R, R) and (Q, Q) are located in the top block (C) and the bottom block (K). These elements are controlled

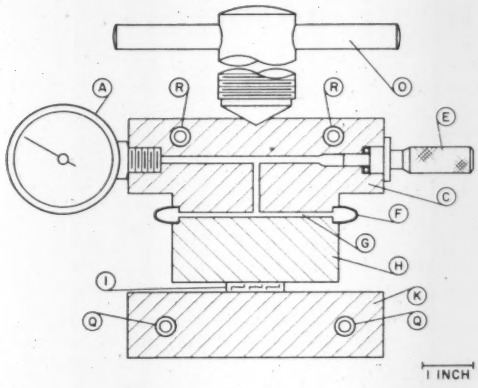


FIG. 9 DIAGRAMMATIC SKETCH OF RELAXOMETER SHOWING BASIC DESIGN FEATURES

by individual thermostats (not shown). Temperature measurement is indicated by thermocouple-type thermometers (not shown) inserted in lower block (K) and piston (H).

Since it is not possible to secure a suitable hydraulic fluid without some volume change due to temperature variation, the micrometer screw (E) also provides the means for maintaining the original thickness of the hydraulic chamber (G). Thus compensation is made for the thermal effects on the fluid. In the apparatus used for these tests a 0.003-in. micrometer-screw movement is required per deg F. The accuracy of the results, of course, is predicated on the accuracy of the gage (A).

Any convenient method of applying pressure or loading can be used, as long as the time of loading can be uniformly controlled.

Relaxation studies were conducted on a Neoprene rubber-bonded asbestos compressed sheet packing; Buna-S rubber-bonded asbestos compressed sheet packing; another type Buna-S rubber-bonded asbestos compressed sheet packing; and a glue-glycerine treated plant-fiber sheet packing. Tests on these gasket materials were carried out under various loads, at various temperatures, and for various time cycles, and are described in the March, 1951, issue of *India Rubber World*, in which Mr. Farnam's paper has been published in full.

Coal Research

THE organized and specialized approach which business has taken for the development of products and markets represents a technical competition that companies and industries must enter into in order to insure their survival, Dr. C. C. Furnas, Mem. ASME, director, Cornell Aeronautical Laboratory, Buffalo, N. Y., told representatives of Bituminous Coal Research, at its recent annual meeting which was held in Columbus, Ohio.

In outlining the product and market-development problems and possible solutions for the coal industry, he said that coal has not kept pace with the procession of research. He said this resulted from coal's coming into widespread industrial and domestic use when organized industrial research was not necessary to profitable business.

Serious competition now forces the coal industry to change its perspective. Research offers the industry an opportunity to realize the potential inherent in coal's make-up, low cost to consumer, and supply. This potential, Dr. Furnas said, is only now beginning to be visualized.

Based on his wide experience in research for other industries, Dr. Furnas proposed some steps the coal industry could take immediately to expand its markets and assist in stabilizing operations: (1) Capitalize on coal's potential through an extensive, continuing, well-integrated research and development program; (2) improve the old and discover new uses for coal as a fuel and develop coal as a source of chemical raw materials; (3) give greater attention to market possibilities and problems of the coal user, with particular emphasis on by-products; (4) promote continuous vigorous development of worthy research findings; and (5) as the best investment the coal industry can make, increase the support of its co-operative coal-research program by at least tenfold.

He said that the existence and vital activities of BCR are evidence that the coal industry realizes its competitive responsibilities in industrial operations of growing complexity. As the industry has grown the need has grown, also, for those groups who are assigned the task of applying their full efforts toward welding scientific knowledge and inventiveness into new and better products and processes.

These research teams conduct investigations into the nature and workings of natural materials and laws. They apply these fundamental concepts to specific processes, materials, and devices toward a predetermined objective. When this objective is found to be attainable, the product or process discovered through applied research is developed to establish whether it is practical from the standpoint of both economics and use. These are the functions a co-operative research effort can handle for the coal industry.

Dr. Furnas felt the problems in improvement of mining and transportation of coal are being seriously and vigorously attacked.

In support of this mining development he urged considerable applied research into such subjects such as bursting strength of materials, transfer of fracture through coal seams, abrasion of cutting tools, etc. These, he said, constitute the type of continuous research activity which can be termed "knitting work" made up of a number of small research advancements which are not particularly glamorous but which are an important part of successful development.

In so far as the majority of coal users are concerned, the improvement of devices and systems for utilization of coal as a fuel are the most important Yet, he said, no one has a really clear picture of the exact mechanism of combustion. The more we learn about it the more successful we probably will be in difficult applications.

The use of coal as a source of chemical raw materials has been only slightly realized.

Coal, Dr. Furnas said, should dominate the chemical-material field for three reasons: (1) Low cost of material; (2) almost inexhaustible supply; (3) coal's compounds are built around the benzene ring. Chemical compounds of the benzene variety have always been very important and within recent years their importance as chemical raw materials has increased greatly.

Largely because of inadequate background of research and development, coal—the logical source of supply—is being neglected as a source of chemical raw materials in favor of petroleum which, admittedly, is not as satisfactory and is inherently more expensive. In the chemical field alone there are hundreds of thousands of chemical compounds which can be synthesized from coal. Even a few dozen of these could favorably affect the prosperity of the coal industry.

ASME TECHNICAL DIGEST

Substance in Brief of Papers Presented at ASME Meetings

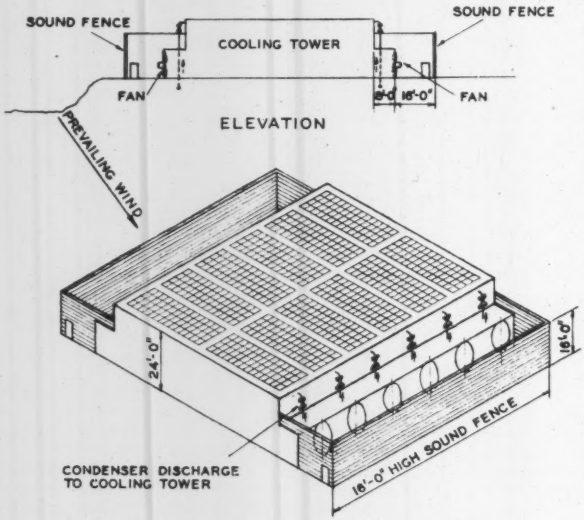
Cooling Towers

Problems Relating to the Operation, Maintenance, and Chemical Control of Cooling Towers for Steam-Electric Generating Stations, by V. F. Estcourt, Mem. ASME, Pacific Gas and Electric Company, San Francisco, Calif. 1951 ASME Spring Meeting paper No. 51—S-10 (mimeographed).

IN A generating station, cooling-tower performance must be considered not only in terms of heat dissipation but also in relation to the over-all results obtainable with a particular combination of tower, condenser, and turbine. There is an important relationship between turbine leaving losses and the optimum tower size. This approach to the subject involves not only the economic size of the tower but also certain operating problems which vitally affect the station heat rate. The problem of condenser-tube scale deposits is more likely to become critical where cooling towers are used due to higher cooling-water temperatures. Successful results are described in the use of threshold treatment of cooling-tower water with stabilized phosphate in combination with sulphur burning for keeping condensers free of scale deposits. The problem of recirculation, fan-blade failures, and noise nuisance are also discussed.

Operating Experiences With Cooling Towers in the Central Gulf Area, by Harry G. Hiebeler, Mem. ASME, Houston Lighting and Power Company, Houston, Texas. 1951 ASME Spring Meeting paper No. 51—S-9 (mimeographed).

THE electric power requirements of Houston, Texas, and the surrounding area are supplied from four major generating stations of the Houston Lighting & Power Company totaling about 625,000 kw in net capacity. Of this, 440,000 kw, or 70 per cent operates on circulating-water systems employing mechanical-draft towers for cooling. Of the other 185,000 kw, 160,000 is at Deepwater, a 1450–350-psi station on the ship channel, and the remaining 25,000 kw in the older 200-psi section of the uptown Gable Street plant. Gable Street also has 65,000 kw (gross) in two modern 850-psi 900 F



MAIN COOLING-TOWER LAYOUT MARTINEZ STEAM PLANT, CONTRA COSTA COUNTY, CALIF.

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units on towers. The largest units on towers are the two 85,000-kw machines at the West Junction station, which, with a total of 250,000 kw (gross) on towers, should rate it well toward the top of the list of large central stations wholly on such systems. It will, however, within the next two years, be dwarfed when two machines of 110,000 kw gross each are added to the 140,000 kw already in service on towers at the Greens Bayou station. This will total 360,000 kw (gross) at this site and 650,000 kw net on towers for the system.

Experience, at Houston, with towers goes back about 12 years to the installation of a small forced-draft tower to serve a 25,000-kw machine at Gable Street. This was followed by a 40,000-kw unit in 1943 at West Junction also on a forced-draft tower and by a duplicate machine there on an induced-draft tower in 1947. Two units of 70,000-kw capacity each on induced-draft towers went into service in 1949 at Greens Bayou. Another machine, 35,000 kw, on an induced-draft tower was completed last spring at Gable Street. An 85,000-kw unit with induced-draft tower came last August at West Junction with a duplicate machine added in February there.

Experiences with these installations are outlined and discussed.

On the whole, while there have been some operating difficulties and problems with the towers, these are not insurmountable. Possibly the biggest problem facing the tower operator will be to combat deterioration of the wood. In this connection substitution of other materials such as transite should be investigated.

Deterioration of Wood In Cooling Towers, by R. H. Baechler and C. Audrey Richards, U. S. Department of Agriculture, Forest Products Laboratory, Madison, Wis. 1951 ASME Spring Meeting paper No. 51—S-11 (mimeographed; to be published in Trans. ASME).

PRELIMINARY investigations described in this paper were intended to throw some light on a few of the many questions that have arisen regarding wood failure in cooling towers. A brief discussion of the nature of wood, the kinds of deterioration it may undergo, and the conditions to which it is exposed in a cooling tower are given.

Redwood is the species used almost exclusively in the construction of cooling towers. Its principal advantages over other species lie in its inherent resistence to decay, its relative freedom from distortion with changes in moisture content, and its availability in the clear grades needed for this purpose.

The premature failures of redwood in cooling towers have been attributed to one of two causes, living organisms called fungi, which are responsible for decay, and chemicals present in the water.

A third type of deterioration, physical erosion of the wood by the water, no doubt plays a role in the gradual reduction in cross section that occurs in members exposed to a continuous flow of water. Suspended matter in the water would be expected to intensify this eroding effect.

Pieces of slats removed from 12 towers after six to eight years' service, and exposed to five fungi in laboratory tests, showed much greater loss in decay than pieces of unused redwood. Thin cross sections exposed to solutions of sodium carbonate and sodium hypochlorite were less resistant to decay than those exposed to water.

Management

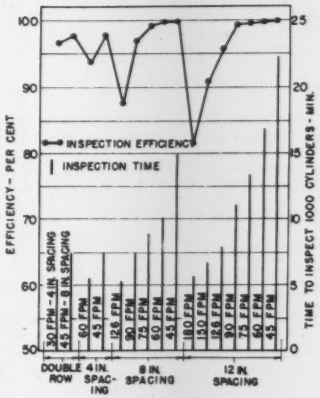
Optimum Speeds of Translation and Rotation for the Visual Inspection of Cylindrical Surfaces, by E. Paul DeGarmo, Mem. ASME, E. C. Keachie, Assoc. Mem. ASME, University of California, Berkeley, Calif., and A. L. DeHart, Monterey Peninsula College, Monterey, Calif. 1951 ASME Spring Meeting paper No. 51—S-19 (mimeographed).

TESTS were conducted to determine what speeds of translation and rotation would be most efficient, where cylindrical objects are passed in front of inspectors who are inspecting for visible surface defects. Single-row versus double-row arrangement and various spacings were investigated. Both inspection efficiencies and time requirements were determined. From the results obtained, the optimum conditions to obtain a given inspection efficiency in the minimum time may be determined.

Sufficient data were collected to make the following statistically valid conclusions when the cylinders were approaching the operator from right to left in a single row at 12-in. intervals:

1 The optimum combinations of translation and rotation in terms of worker satisfaction and efficiency occurred at a translational speed of 90 fpm and a forward rotation of 80 rpm (41.8 fpm surface speed). The operators consistently worked at an efficiency better than 99 per cent.

2 Efficiencies decreased with an increase in translational speed above 90 fpm.



INSPECTION TIMES AND EFFICIENCIES UNDER VARIOUS CONDITIONS

3 Forward rotation produced better efficiency scores and was preferred to backward rotation by all operators.

4 Lower standard deviations from the mean efficiencies, showing dispersion, occurred generally at the lower translational speed and at forward rotations.

5 The combination of 126 fpm and backward rotation of 40 rpm (20.9 fpm surface speed) caused severe feelings of nausea to four of the six operators and a mild nausea to a fifth.

The following conclusions are based upon tests for which sufficient data had not been collected to make the results as statistically valid as the previous ones. However, they should serve as good indications for the direction of further investigation and in themselves are of importance.

1 Right-to-left approach versus left to-right approach had no significant effect on the efficiency, but all of the operators preferred the cylinders to approach from right to left.

2 Spacing of 8 in. and 4 in. with a lower translational speed increased the productivity and was preferred by the operators to the wider 12-in. spacing at higher translational speeds.

3 Increasing the number of parallel rows increased the productivity for a given efficiency, probably due to an operator's ability to inspect more than one cylinder at a glance.

4 The trend was toward an increase in productivity with an increase in rows and closer spacing for a given efficiency, but there is undoubtedly a point where an increase in the number of rows at the expense of the translational speed would no longer increase the productivity be-

cause there would be so many cylinders in view at the same time that too little attention could be given to each cylinder.

The Integration of Organization and Management, by R. T. Livingston, Mem. ASME, Columbia University and Long Island Lighting Company, and D. B. Hertz, Jun. ASME, Columbia University, Culpepper Hertz Incorporated, New York, N. Y. 1951 ASME Spring Meeting paper No. **51—S-1** (in type; to be published in Trans. ASME).

MANAGEMENT is a most important element contributing to our survival as a culture. Management, as an art, has provided no quantitative tools for study and use. Such tools must be provided by an adequate and testable theory of association and its operation, which deals with human behavior. The theory will be based on the premise that human beings are the core of all associational activity. The mutual interactions and interdependencies of materials, machines, and men must be studied and measured, within the framework of the dynamic process of the social order, to provide the needed theory. The characteristics of groups, and the determinants of their activities are established, with brief details of organization structure. The practical aspects of an integrated theory of organization and management indicate that powerful tools can be made available in this field if sound premises are used for inquiry, experiment, and research.

The Application of Statistical Techniques in Time Study, by George D. Wilkinson, Mem. ASME, Paul B. Mulligan & Company, New York, N. Y. 1951 ASME Spring Meeting paper No. **51—S-26** (mimeographed).

TIME study is a research function of production, and the problem of the time-study analyst is similar to the problems of research workers in many other fields. He has a mass of numbers representing measurements of a more or less closely defined phenomenon. His task is to translate all of these numbers into a single figure to represent not only the data he has accumulated but also any other set of similar data which he or anyone else might gather.

Methods of treating time-study data advocated in current textbooks vary according to the personal preferences of the author. The usual methods for determining a value to serve as a standard, the mean, median, and mode, have their supporters. In addition, some unique techniques have been developed. Typical of these is the "selected minimum," in which the analyst chooses the lowest time recorded for each motion-time element, unless this minimum time seems to him to be too low—or possibly not low enough—in which case he selects some other "minimum" from his set of readings. In practically every case, regardless of the method proposed, the analyst is advised to circle values which are "too high" or "too low" and to omit them from his calculations. Thus, in addition to whatever subjective factors may have been introduced, when the data were leveled or rated, or by the errors in reading the stop watch, another element is introduced when an attempt is made to translate the data into a time standard. It is not inconceivable that the next step in the development of this approach will be the announcement that no stop watch is needed at all, because the trained and experienced man can decide by merely watching an operator and applying his highly developed sense of "normal time" not only the relative rate of speed at which he is working, but how long he ought to take to do it.

Developments in the field of inspection in recent years point the way for time-study engineers. The use of statistical techniques have offered so many economic and technical advantages for controlling quality that engineers are adopting them. Statistical quality control is making remarkable contributions to the techniques of statistics. Intricate formulas and the involved discussions of the validity of the techniques employed, have been replaced with a few simple formulas, some easily understood tables, and a set of charts to portray graphically the results so that they can be grasped easily by the nontechnical mind.

The chief objection, presumably, to the use of statistical techniques to obtain averages of time-study data is that they are too complicated to be used economically by time-study departments pressed to develop standards. The comparatively recent developments in statistical quality control, however, have pointed the way to overcome this objection. Most of the complicated and difficult computations can be standardized and set up in tables. Then the procedure for making an objective determination of the validity of the average can be made simple enough to be followed by anyone with a good grounding in arithmetic, and the only judgment involved is a simple determination as to whether a given number is greater or less than another one.

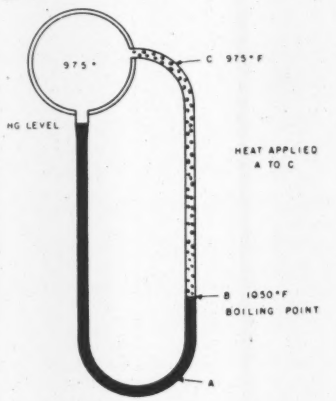
Power—Fuels

Mercury Boiler Treatment With Titanium and Magnesium Metals, by Richard C. Reid, General Electric Company, Schenectady, N. Y. 1951 ASME Spring Meeting paper No. **51—S-13** (mimeographed).

THE treatment of boiler mercury by the addition of titanium and magnesium metal to the circulating mercury of a boiler has been successful in eliminating the attack of mercury on the boiler steel and maintaining wetting of the boiler surface which provides good heat transfer.

This paper presents a discussion of the mechanism of this dissolving action in a circulating mercury-tube circuit by means of a constitutional diagram of the mercury-iron system, and then to establish by means of the mercury-iron, mercury-titanium, and iron-titanium diagrams the conditions that occur in a circulating boiler tube when titanium metal is added to this system. The effects of oxygen in this mercury-boiler system and the action of magnesium in dilute solution in the removal of oxides and maintaining wetting in the circulating mercury is also discussed.

Mercury treatment at the South Meadow Station of the Hartford Electric Light Company is an example of the successful application of magnesium and titanium to a large mercury-boiler installation. This type of mercury treat-



SIMPLE MERCURY BOILER-TUBE CIRCUIT DIAGRAM

ment is used in all the mercury power plants now in service.

Effect of Taper on Screw-Thread Load Distribution, by E. E. Stoeckley, Mem. ASME, and H. J. Macke, Jun. ASME, General Electric Company, Schenectady, N. Y. 1951 ASME Spring Meeting paper No. 51—S-15 (mimeographed).

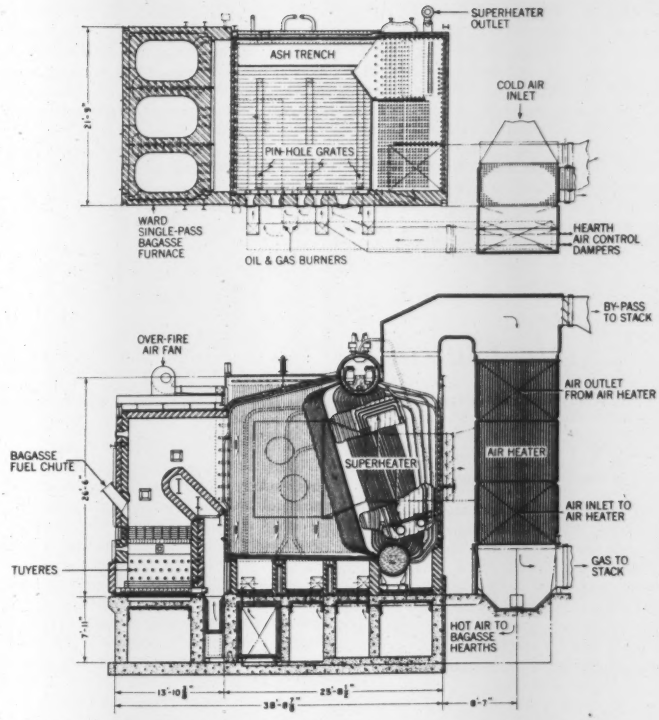
THE load distribution on the threads of bolts and nuts, made in the conventional constant-pitch manner and with tapered threads, was determined experimentally and theoretically. The results indicate that substantial improvement, in the order of two to one, in thread load distribution can be made by properly tapering the thread of either the bolt or nut. Material improvement in bolting strength is obtained in applications that normally are conducive to little plastic flow and thus liable to result in brittle fractures, such as are encountered with dynamic loads or static loads at elevated temperatures. Ten years of operational experience on high-temperature high-pressure turbine bolting are cited to substantiate indicated improvements.

Fuel Availability and Its Influence on Boilers and Burning Equipment, by P. R. Loughin, Mem. ASME, The Babcock & Wilcox Company, New York, N. Y. 1951 ASME Spring Meeting paper No. 51—S-17 (mimeographed).

THIS paper outlines some of the properties of various fuels and depicts a few applications where fuels of widely varying characteristics are being burned in the same units meeting the present-day requirements of versatility of boilers and burning equipment.

In general, the industrial and utility steam plants burn coal, oil, and natural gas. In steel mills the fuels that must be economically used include coal, oil, natural gas, blast-furnace gas, and coke breeze. Pulp mills are currently using coal, oil, natural gas, bark, wood, and "waste" liquors from the pulping process. Oil refineries burn coal, oil, refinery gas, sludge, and petroleum coke. Sugar mills use coal, oil, natural gas, and bagasse.

In some parts of the country, economics and availability still clearly indicate that only one fuel will be burned on many boilers in industrial and utility steam plants for the predictable life of the equipment. In an increasing number of localities, the fuel most economical to burn varies from time to time. The need for an alternative emergency fuel is becoming a "must." In recent years



TYPICAL UNIT FOR A SUGAR MILL ARRANGED FOR FIRING OF BAGASSE WITH OIL AND GAS FOR ALTERNATIVE FUELS

the operators and designers have adopted a more realistic view of their future in fuels and require that the equipment installed be capable of efficient operation with varying types and qualities of fuels that will have to be used during the foreseeable life of the equipment.

Machine Design

Determination of the Effective Strained Length of Standard Stud Bolts, by Robert S. Sherwood, Mem. ASME, and Richard C. Dove, Jun. ASME, Iowa State College, Ames, Iowa. 1951 ASME Spring Meeting paper No. 51—S-2 (mimeographed).

PROBABLY no other single machine element is used as often and for so many important applications as the threaded fastener. This fact has led to research and development which have resulted in continuous improvement of both fastener and the technique employed in its use. One of the most persistently troublesome problems from the designer's point of view has been, and continues to be, the difficulty encountered in determining and controlling initial tightening stress in the fastener.

Because of the importance of initial stress in fasteners, a considerable amount of work has been devoted to finding a reliable and convenient means for initial stress control. There are, at the present time, two distinct methods for controlling the initial tensile stress in a fastener. The first of these is commonly referred to as "torquing."

The second method of controlling the initial tension in a fastener is to specify the amount by which the bolt is to be elongated. This method requires that the original and final lengths be accurately determined, and that this elongation be related to initial tension. The determination of change in length presents no problem in cases where both ends of the fastener are exposed; but for the present, at least, the elongation method is limited to these cases.

This paper is a report on a project which was undertaken in 1949 in an attempt to determine a better method

for relating initial tensile strain in a threaded fastener to the over-all elongation produced during tightening. Errors being made in the present method of relating initial tensile strain to elongation are discussed, and a new formula relating initial tensile strain and elongation is presented. The experimental technique used to evaluate the two parameters contained in the proposed formula is outlined. Sufficient values of these parameters are presented to allow the proposed formula to be applied to standard stud bolts within a limited range of diameters.

Textile Industry

ASME Analyzes Textile-Mill Modernization, by L. A. Runton, M. T. Stevens & Sons Company, North Andover, Mass. 1950 ASME Fall Meeting paper No. 50—F-34 (mimeographed; re-presented at the 1951 ASME Spring Meeting).

THE ASME Textile Division is analyzing textile-mill modernization so that it can serve the textile industry in a manner neither heretofore possible nor actually desired. The group feels the timing now is right as there are definite indications that textile management desires reliable information in regard to accomplishments being obtained in newly developed areas, using new methods in management, selected plant environment, machinery layouts, and materials-handling methods.

The ASME Textile Division feels that the present trend of world events demands a greater than ordinary effort in carrying out such a program.

Other important influencial indications are the following:

1 The Atlantic City Textile Machinery Exhibition definitely placed the United States in a leading position in so far as textile-machinery development is concerned.

2 Marginal mills which have enjoyed profitable operations over a period of ten years are gradually liquidating and going out of business to a measured degree.

3 Woolen and worsted mills which have been newly established in the south, and other sections, have definitely proved their ability to produce a full range of fabrics on an entirely competitive quality basis, and at lower manufacturing costs.

This paper presents a skeletonized portrayal of the methods employed in the development of these new plants which have established manufacturing costs lower than those currently obtainable in other parts of the country.

This paper is also designed to acquaint listeners with the methods which will be used in presenting information, and how it can be used. In the body of this paper, the steps which can be taken in the potential usage of the data shown are covered in detail.

The main objectives are to reduce operating costs and to improve product quality. If either or both of these objectives is attained, it is logical that a substantial net gain will be secured.

Hydraulics

The Exact Analogy Between Free Surface Water Flow and Two-Dimensional Gas Flow, by V. G. Szebehely and L. F. Whicker, Virginia Polytechnic Institute, Blacksburg, Va. 1951 ASME Spring Meeting paper No. 51—S-22 (mimeographed).

THE well-known analogy between free surface water flow in a rectangular channel and two-dimensional gas flow is only qualitative since the analogy assumes "hydraulic gas" with $Y = c_p/c_v = 2$, which value for air is 1.4. In this paper the velocity of propagation of long gravity waves in channels of arbitrary cross section is derived and a relation is found between the shape of the channel and the corresponding $Y = c_p/c_v$ ratio for gas flow. Based on this relation a newly designed channel is presented and it is shown that using a triangular section of arbitrary angle instead of a rectangular, a value of $Y = 1.5$ can be obtained. A general treatment shows that if the channel cross section is parabolic, then $Y = 1.4$ value can be obtained, with which the analogy becomes exact and quantitative measurements are possible. The corresponding temperature, pressure, and density relations in the gas flow are treated in both the general and the special cases.

The origin of the so called "Hydraulic Analogy" was traced back to E. Jouguet's paper published in 1920, who proposed an analogy between two-dimensional gas flow and flow of water in an open rectangular channel and gave direct proof by exact mathematical analysis. He introduced the concept of a gas which has an adiabatic gas constant (Y) of 2 and called it "hydraulic gas." It is interesting to note that in the past 30 years several theoretical and experimental papers contributed to this analogy, accepting the initial error of $Y = 2$ without trying to introduce a "better" hydraulic gas. The analogy holds for subsonic as well as for supersonic flows. It can be expected that the classical hydraulic gas will show little deviation from air in cases when the value of the adiabatic constant is not one of primary interest. Therefore, even the relatively recent NACA reports deal with the subsonic applications of the analogy and no experimental investigations were presented with respect to high-Mach-number flow except of the water-table experiments of Gilmore, Plesset, and Crossley which showed no, or very little, agreement with the actually observed phenomena in air or with theoretical values.

The aim of this paper is neither to improve the experimental techniques nor to discuss them but first of all to investigate theoretically the possibilities of extending the use of the analogy for shock-wave problems. In fact, from theoretical investigations a general relationship is derived which correlates the shape of the cross section of the channel with the adiabatic gas constant.

ASME Transactions for May, 1951

THE May, 1951, issue of the Transactions of the ASME (available at $1 per copy to ASME members; $1.50 to nonmembers) contains the following:

TECHNICAL PAPERS

The Manufacture of Small Ice, by Crosby Field. (50—A-5)

Carbide High-Velocity Turning, by Leif Fersing. (50—A-127)

High-Speed Aerodynamic Problems of Turbojet Installations, by H. L. Luskin and H. Klein. (50—A-102)

Heat Transfer in Rocket Motors and the Application of Film and Sweat Cooling, by R. H. Boden. (50—A-53).

Centrifugally Cast Bronze-Back Bearings for Heavy-Duty Operation, by L. M. Tichvinsky. (50—A-106)

A Study of Head Loss in Venturi-Meter Diffuser Sections, by Joel Warren. (50—A-65)

Discharge Measurements by Means of Venturi Tubes, by A. L. Jorissen. (50—A-71)

Controller Settings for Optimum Control, by W. A. Wolfe. (50—A-22)

Furnace Heat Absorption in Pulverized-Coal-Fired Steam Generator, Willow Island Station:

Part I Furnace Heat-Absorption Efficiency as Shown by Temperature and Composition of Gases Leaving the Furnace, by J. W. Myers and R. C. Corey. (50—A-83)

Part II Variation in Heat Absorption as Shown by Measurement of Surface Temperature of Exposed Side of Furnace Tubes by F. G. Ely and N. H. Twyman. (50—A-82)

Discussion of the two preceding papers

Stress Distribution in the Continuous Chip—A Solution of the Paradox of Chip Curl, by E. K. Henriksen. (50—SA-9)

COMMENTS ON PAPERS

Including Letters From Readers on Miscellaneous Subjects

Standardized Boiler Units

COMMENT BY FRANK GILO[1]

The author has given an excellent description of and enumerated some of the benefits of standardized boiler units.[2] While we agree that there are tremendous advantages obtainable by using standardized boiler units, there are a few statements in the paper which need clarification from another viewpoint.

The paper may leave the impression that standardized boiler units are limited to boilers of capacities to 60,000 lb per hr and pressures to 400 psi. Actually, our standardization has proceeded to a point where we have a complete line of boilers of various types and sizes, and capacities to 350,000 lb per hr, and steam conditions of 1050 psi and 1000 F. We also have standardized on units or parts of boilers of capacities above 350,000 lb per hr. Inasmuch as turbine manufacturers have established preferred standards in sizes of 30,000 kw, 40,000 kw, 60,000 kw, and 90,000 kw, we have developed boiler designs which are available in sizes to generate the steam required for the preferred standard turbines.

Of course, some flexibility in design is desirable and advisable for any line of boilers to accommodate the requirements which arise to satisfy changing economic conditions, such as the following:

(*a*) Available fuels.
(*b*) Building requirements.
(*c*) Over-all operating costs.

We provide flexibility in our standardized designs to take care of these variables, incorporating features of design and design details that have been proved by experience.

In setting down the basic design principles for standardized boilers overemphasis has been given to the need for uniform steam generation across the width of the boiler to avoid overloading one part of the drum. The thousands of our F-type boilers serving many industries and utilities and giving satisfactory service with horizontal gas flow in three passes give definite proof that uniform steam production per foot of drum is not important when all factors which should be taken into account have been considered in the design. It then becomes a function of having adequate steam-separating device in the drum to permit taking advantage of other features to produce a compact unit which will satisfy all of the customer's requirements.

There may be some who will interpret the author's remarks as proof that forced circulation is better than natural circulation. While undoubtedly there are some problems which can best be solved by using forced-circulation boilers, it should not be overlooked that natural-circulation boilers of standardized and nonstandardized types are available from most boiler manufacturers in many sizes and types. Before purchasing a forced-circulation unit, it is presumed that a customer would weigh the advantages and disadvantages of both types of units. Our company has developed natural-circulation units in standardized and nonstandardized types for pressures up to 2650 psi and, while we also have built forced-circulation boilers for marine and steamotive applications, our customers have generally felt that the disadvantages of forced-circulation units more than outweigh the advantages as compared with natural circulation, taking into account such items as the following:

(*a*) Water treatment.
(*b*) Reliability of mechanical pumps, as compared with the thermal pump which nature provides in the natural-circulation boiler.
(*c*) Relative power requirements for the two types of circulation.

We feel that pressure-firing is here to stay, and our company has developed pressure-type designs in both small and large units. The latest addition to the pressure-type unit is the type FM boiler which is designed in capacities from 7000 lb to 25,000 lb of steam per hr for oil and gas firing, and the operating experience with this type of unit has been exceptionally good. The statement in the paper, "the construction is more expensive and the operation of the unit becomes more difficult," does not agree with our experience. Actually, the construction that we use in making the casing tight against the pressure of the forced-draft fan is a much simpler construction than the marine-practice construction referred to in the paper which required a double casing. The results from the installations already in service prove that pressure-casing installations actually are easier to operate and less expensive when the factors of increased efficiency resulting from operation with lower excess air, lower fan-power consumption, and elimination of induced-draft-fan maintenance are considered.

In conclusion, we agree that it is desirable to take advantage of all of the benefits which come through the use of standardized boiler units, such as lower cost, less fabrication and erection time, and the elimination of unnecessary engineering work required by tailor-made design. We all understand, however, that there will continue to be cases where other than standardized designs must be used to satisfy the particular requirements of a customer.

COMMENT BY C. F. HAWLEY[3]

As one who has worked on boiler-standardization programs, the writer can well appreciate the amount of work and effort represented by this paper. The author's statement of the basic design principles is an excellent presentation of the requirements and the difficulties encountered by the designer when he attempts to produce a satisfactory furnace for several different kinds of fuels. This is the basic difficulty with standardization in this field, and the author apparently has covered this with two designs, one for oil and gas fuels and one suitable for all types of coal firing, together with oil and gas.

In this connection the writer was particularly interested to note the author's emphasis on adequate furnaces for all possible kinds of fuel burning. The state of the fuel market is such, particularly on the eastern coast, that any purchaser is foolish not to provide for at least the future necessity of burning low-grade coal.

[1] Application Engineer, Babcock & Wilcox Company, New York, N. Y. Mem. ASME.

[2] "Standardized Boiler Units," by C. E. Miller, MECHANICAL ENGINEERING, vol. 73, January, 1951, pp. 9–13.

[3] Assistant Chief Mechanical Engineer, Riley Stoker Corporation, Worcester, Mass. Mem. ASME.

The extra cost involved is a small part of the possible future saving, but too many times the designer is confronted by a buyer who will consider only the cheapest possible arrangement to produce steam under the most ideal conditions. This, of course, is a matter of education which must be promoted by the seller and particularly by consulting engineers.

The present trend to outdoor or semioutdoor boiler installations will make it easier to promote standardized units because the necessity of fitting the design into a nonstandardized boilerhouse will be eliminated.

AUTHOR'S CLOSURE

In the original paper emphasis was placed on the smaller sizes of boilers because it is in this field where the greatest degree of standardization has already occurred. Therefore, Mr. Gilg's clarifying remarks that standardized boilers are also available in the larger sizes, from the major manufacturers, are appropriate. Because of space limitations, a discussion of larger sizes was omitted. It involves generally a slightly different technique consisting more of combining standardized parts rather than a completely standardized assembly. This could well be the subject of another paper with particular emphasis on methods for accommodating various fuels.

The subject of circulation, particularly as it concerns high-pressure boilers is very broad. Considerable operating experience is now available on both natural and forced or controlled circulation and these records, as well as modern trend in design, are being carefully studied by power engineers. Because of the increasing number of high-pressure units required for the larger public-utility plants, the subject is of major interest at the present time. However, discussion has so many phases, it would be impossible to adequately cover it here. It is my understanding that a session on high-pressure-boiler circulation is being scheduled by the ASME Power Division for the Society's 1951 Annual Meeting at Atlantic City. This would probably be a more appropriate time and place to analyze and discuss the subject.

We agree that pressure firing has some advantages in certain applications. But it is questionable if it is a universal answer to all types of installations. For example, it is questionable whether any manufacturer would want to consider furnishing a stoker-fired unit for pressurized operation. Variables such as the size of the unit, kind of fuel, type of firing, fuel cost, and load factor all affect the choice. Each case requires an engineering analysis so that all of these factors can be properly evaluated, and a sound decision made on the basis of all the facts.

Mr. Hawley's remarks are appropriate as he had added emphasis to two points which are important in the application of standardized boiler units: (1) the necessity for having adequate furnaces so that maximum fuel flexibility is provided, and (2) the increased scope of the application of such units because of the trend toward outdoor or semioutdoor installations where space limitations are less restrictive on design.

CARL E. MILLER.[4]

[4] Combustion Engineering-Superheater, Inc., New York, N. Y. Mem. ASME.

Grinding Fluids

COMMENT BY FRANKLIN VEATCH[5]

The technique employed to measure metallic loading of the grinding wheel[6] appears to be novel, nonambiguous, and revealing while employing simple and inexpensive equipment. Such techniques are much needed in the metal-processing fields where the variables are usually so numerous and difficult to examine independently that the actual operation must be studied to give valid conclusions. The general approach in the selection of test steels, conditions, and precautions observed is excellent and, obviously, the result of an experienced hand in this type of test work.

For production people who might like to employ such a technique to follow the condition of their grinding wheels, the rather tedious counting and simultaneous decisions on minimum particle size is undesirable. It seems possible that some sort of a "grained" paper of the "imbibition" type might serve to facilitate the counting observations, either from the number or size standpoint, probably, however, at some slight expense of accuracy.

Because of the rather wide variations which must occur in the count per unit area under a given set of conditions, most experimenters probably would prefer to use an average of more than 2 counts for maximum accuracy.

[5] Chemical and Physical Research Division, The Standard Oil Company (Ohio), Cleveland, Ohio.

[6] "Grinding Fluids," by L. H. Sudholz, S. Manilych, and G. S. Mapes, MECHANICAL ENGINEERING, vol. 72, December, 1950, pp. 963–965 and 983.

COMMENT BY H. W. WAGNER[7]

The paper is very well organized and ends with a logical summary. The work shows success in evading pitfalls of experimental error which lie in wait for all who conduct experimental grinding. The method employed for counting spots of load is clever and appears to be reliable.

Three comments are offered concerning the physical aspects involved:

1 Metallic loading does more than fill the pores of the wheel face. It is believed that many of the larger particles, as illustrated in the paper, lap over abrasive cutting points. The effects are to increase grinding pressure, power consumed, and heat generated, and to mar the finish, all of which are detrimental to the operation.

2 The requirement of removing 30 mils from the wheel face to eliminate all the load is interesting in that it indicates that some of the load is driven further into the wheel structure by diamond truing.

3 Steel removed per run is calculated to be about $\frac{1}{4}$ or $\frac{1}{2}$ cu in. and to take about 2 min of grinding. These figures are named to emphasize the facts that loading can occur quickly and that economy is enhanced by selecting a fluid which permits little or no loading. The steel removed depends upon whether the infeed reported is on the diameter or radius of the work. It should be specified.

If the writer may be so bold, the following suggestions are offered for consideration by the authors in future experiments:

1 Make extensive use of power records for evaluation of performance. Lower power, meaning greater freeness of cut, can be had from a softer grade of wheel, but wheel life is then reduced. For equal wheel wear, power is an excellent quantitative measure of the gain derived from a grinding fluid.

2 Include a nonwater grinding oil and a richer compound-water mixture, as 1:25 or 1:15. Our experience leads to an expectation of still less metallic load when the percentage of water is reduced below that in the 1:50 mixture.

3 Include additional brands of nonpetroleum compounds which might be called "synthetic solubles." A large range of loading may result, as was found among the three "soluble" oil fluids reported.

4 Add 18-8 stainless steel or aluminum to the work materials. Either will provide an exacting target for the fluids to shoot at in overcoming metallic loading, but will not necessarily require the same

[7] Norton Company, Worcester, Mass.

fluid that steels, described in the paper, do.

5 Determine whether a thin film of metal on the flat of a worn abrasive grain will register as load on the imbibition paper. One way to form the film is to grind hardened steel at a slow rate with the A80-M5VBE wheel or with a coarser one having 36 or 46 grit abrasive to provide larger areas of flats

AUTHORS' CLOSURE

The authors believe that Mr. Veatch is entirely correct in stating that for use in actual service conditions the rather tedious procedure of counting particles of minimum size would be undesirable. The suggestion that some sort of "grained" paper might serve to facilitate the counting observations would certainly be of interest to production personnel. Obviously, in our laboratory investigation this was not an important factor. It is true that a wide variation occurs in the degree of wheel loading per unit area of wheel face. However, only two counts were made at those areas where the loading was most severe, since it was believed that they were largely responsible for the actual grinding efficiency and resultant surface finish.

With respect to the comments offered by Mr. Wagner, the observation regarding wheel dressing is quite interesting. Mr. Wagner states that since it is necessary to remove 30 mils from the wheel face to eliminate all load, it is indicated that some of the load is driven further into the wheel structure by diamond truing. The infeeds reported are on the radius and not on the diameter. Regarding the suggestion on future work, concerning the importance of power measurement for determining performance, the latter is in accordance with our recent observations. The authors agree that the addition of 18-8 stainless steel as a work material would impose different grinding-fluid requirements with respect to prevention of metallic loading.

L. H. SUDHOLZ.[8]

[8] Socony-Vacuum Laboratories, Brooklyn, N. Y.

The Shortage of Engineers

TO THE EDITOR:

This is supplemental to Dr. Hollister's article on the shortage of engineers, to Mr. Bochenek's article on optimum use of engineering manpower, and to the three editorials, all in the February, 1951, issue of MECHANICAL ENGINEERING. All these boil down to the fact that engineering service is probably vital to the very preservation of our country, and that it is in short supply.

Three things are pertinent to engineering service:

1 Rendering of service by the engineer. (This presumes that he is qualified by training and ability for efficient service.)

2 Payment for that service by employer or purchaser or user of his product.

3 Compulsion of said payment by government, by some branch of government, to the same extent that government now compels payment of wages to carpenters, plumbers, and plasterers.

If payment is not compulsory, then in many cases, it will not be made. And all the registrations of engineers and personnel boards under the canopy of heaven cannot produce maximum engineering service if it is not paid for and is thrown open to pillage by Goths and vandals.

Invention is the fountainhead of engineering. It is inventions that have made our big advances, and that have blazed the engineering trail. And under present laws, the government can, in emergency, make and use any patented invention in peace or war.

Now suppose a man is manufacturing and selling a patented invention. He pays taxes. Those taxes go to pay courts and sheriffs to protect the owners of pigs and plows and playgrounds, but not to protect himself. When he has developed his invention mechanically and commercially, anybody, anywhere, can start making and marketing his same invention, without payment or even a "Thank you" to the patentee. And all public officers sit with arms folded and look on. The patentee can, indeed, bring civil suits at an expense beyond the means of any ordinary citizen, and with infinitesimal chances of "securing" his "exclusive right." Such prostitution of inventions does not induce young men to enter the engineering profession, and does not justify engineers already in the profession in spending their time and money developing their creations. The showdown has come. In our crucial need, we find engineers in short supply.

Have we the courage to cut loose, now and forever, from this practice that has neither reason nor justice nor constitutional authority, and build on our good old United States Constitution and on sound common sense? Give to engineers what is rightfully due them, and the engineers will be on the job and will produce!

JOHN W. KITTREDGE.[9]

Furnace-Brazing Machine Parts

COMMENT BY J. D. FERNBACH[10]

The superior strength of brazed joints, as noted in the paper,[11] cannot be questioned; however, it is obvious that the joint strength is in direct proportion to the tightness of fit between the components being joined. It naturally follows that close tolerances and resulting high costs prevail.

In an effort to reduce the cost of component parts, at an admitted sacrifice in strength, an investigation is in progress to determine the economies and characteristics of brazed joints where the male part, usually a stud, is knurled and pressed into the hole prior to the actual brazing.

Indications to date are that satisfactory joints are possible; however, data are as yet incomplete. The writer would appreciate any information along this line from the author or other interested readers.

AUTHOR'S CLOSURE

Others have recognized the advantages indicated, using knurled parts, and are using the method in production. Economies are claimed, but the author has no data on characteristics of the joints.

H. M. WEBBER.[12]

Public Relations

COMMENT BY R. TOM SAWYER[13]

On the subject of "Public Relations,"[14] the author has brought up the matter of co-ordinating the various societies in order to make engineers stand out as individuals, even to the extent of having a symbol for engineers just as there is a symbol for all doctors. However, he has not submitted any concrete plan for this

[9] Mem. ASME.

[10] Assistant Production Engineer, International Business Machines Corporation, Endicott, N. Y.

[11] "Furnace-Brazing of Machine Parts," by H. M. Webber, MECHANICAL ENGINEERING, vol. 72, Part 1, November, 1950, pp. 863–869; Part 2, December, 1950, pp. 969–976.

[12] Industrial Heating Divisions, General Electric Company, Schenectady, N. Y.

[13] Manager, Research Department, American Locomotive Company, New York, N. Y. Mem. ASME.

[14] "The Engineer's Stake in Public Relations," by J. D. Waugh, MECHANICAL ENGINEERING, vol. 72, December, 1950, pp. 984–986.

and I am interested to know what he proposes.

At the present time there is such a vast number of engineering societies, and they are so interwoven, that their relationship reminds me of a Diesel-locomotive wiring diagram which is just about the size of the proverbial "barn door." These wiring diagrams are put on one sheet of paper so that the trained engineer can easily trace all the circuits. However, for the student engineer and those interested only in certain phases of the diagram, these circuits have been separated carefully, keeping each subject on a separate sheet of paper.

I am certain that the average engineer today considers the network of engineering societies as a maze of wires on one wiring diagram, and I am interested to know what program the author has in mind to clarify this existing condition.

AUTHOR'S CLOSURE

Mr. Sawyer, with his "wiring-diagram" analogy, has aptly described the chief obstacle in the path of achieving greater professional recognition for engineers. It is because the multitude of society "circuits" are unconnected that there is insufficient power behind the drive to build a more adequate professional symbol for engineering. If the power in the nearly 100 technical societies could be directed through a central station, its effect would be tremendous.

Specifically, I suggest that the coordination, or unity, of the diverse engineering societies be achieved through agreement on a common denominator of interest to all engineers, whatever their field of specialization.

This common denominator is "professionalism," expressed through action on social, economic, ethical, legislative, and public-relations matters. However, agreement on a program of common interest is not enough. Engineers should organize for action to create their symbol. Just as other professions are recognized through their interest in their fellow men, engineers should become identified with service to the community.

Accordingly, the unity or professionalism organization should derive its strength and guidance from individual engineers everywhere, serving as citizen-engineers at the community, state, and national levels. Achieving such an effective democratic unity of the only major unfederated profession offers engineering leaders the greatest challenge and opportunity of their lifetimes.

JOHN D. WAUGH.[15]

[15] Pendray & Company, New York, N. Y. Jun. ASME.

REVIEWS OF BOOKS

And Notes on Books Received in the Engineering Societies Library

Forest Products

FOREST PRODUCTS: The harvesting, processing, and marketing of materials other than lumber, including the principal derivatives, extractives, and incidental products in the United States and Canada. By Nelson C. Brown. John Wiley and Sons, Inc., New York, N. Y., Chapman and Hall, Ltd., London, England, 1950. Cloth, $5^1/_4 \times 8^1/_2$ in., 153 figs., 26 tables, glossary, bibliography, appendix, index, xv and 399 pp., $5.

REVIEWED BY J. HUGO KRAEMER[1]

THIS book is based upon Professor Brown's previous one in the general utilization field, "Timber Products and Industries." The descriptive information and the data on the various industries have been brought up to date. It is well illustrated and the data are presented in both tabular and graphic form.

The preparation of a book of this type, essentially encyclopedic in nature, covering a vast field of subject matter, is always a difficult task. It also involves decisions regarding what to include and what to leave out within each division of the whole field. Professor Brown has gone about this in a workmanlike manner and has succeeded in presenting the high lights of a broad and involved field in a readily readable form. The authenticity of the information is evident from the lengthy list of acknowledgments to other authorities who have contributed information and data, and who have reviewed the manuscript.

There are seven general sections, one on economics and general considerations of the utilization field, followed by sections on construction materials, chemically derived products, wood containers, mechanically reduced products, wood as fuel, and miscellaneous products, such as bark, Christmas trees, ornamental plants, fruits, and so on.

Lumber is not discussed in the book, but the section on construction materials covers general industrial conditions, specifications, and latest developments regarding veneer and plywood, crossties, poles and piling, posts and grape stakes, mine timbers, and lath. Wood pulp and its products, naval stores, wood-distillation products, extractives, rubber, and maple syrup and sugar are covered in the section on chemically derived products. The chapter on extractives is especially interesting for it covers tannins, dyestuffs and such things as cascara, needle oil, mucic acid, and storax. Mucic acid is obtained by hydrolysis of the galactic acid extracted from western larch wood chips. It is used in baking powder, as a substitute for tartaric acid, in treating flour, and as an accelerator for the growth of yeast. Storax is a yellowish, fragrant gum exuded by sweetgum. It is used in medicinal preparations, in incense, and in perfumes, soaps, and tobacco.

Cooperage, boxes and crates, excelsior, wood flour, stock feed, hardwood dimension stock, and wood-densification products are covered and the latest developments outlined. Fuelwood, charcoal, briquettes, and wood gas are discussed in the section on fuel. It is interesting to note that in spite of the great advances and expansion of the pulp and the veneer

[1] Associate in Forestry and Conservation, Agricultural Experiment Station, Purdue University, Lafayette, Ind.

Library Services

ENGINEERING Societies Library books may be borrowed by mail by ASME Members for a small handling charge. The Library also prepares bibliographies, maintains search and photostat services, and can provide microfilm copies of any items in its collection. Address inquiries to Ralph H. Phelps, Director, Engineering Societies Library, 29 West 39th St., New York 18, N. Y.

and plywood industries, as well as several others, and the increased use of other fuels, such as oil and gas, that fuelwood accounts for 12.6 per cent of the total volume of wood cut and still ranks second among the primary wood uses in the country, exceeded only by lumber.

The reviewer finds it hard to let pass a statement such as the one which follows: "Poles and piling are considered best cut during the winter when the sap is down." While it is true that this fallacy is believed by some woods workers, it should not appear in a college textbook and certainly not without explanatory comment to prevent its perpetuation. The author is guilty of occasional "loose" writing and a few too-general statements, but on the whole the book is a good job. There is a glossary of terms used and a bibliography arranged by products.

It is a book for the beginner in the field of forest products and for men in other professions, such as engineering, who want a survey of the entire field without too much specific detail on portions of it.

Books Received in Library

ABC OF IRON AND STEEL. Edited by D. Reebel. Sixth edition, Penton Publishing Company, Cleveland, Ohio, 1950. Linen, $8\frac{1}{2} \times 11\frac{1}{4}$ in. 423 pp., illus., diagrams, charts, maps, tables, $10. Based on a prize-winning series of articles which appeared in "Steel," this book describes in readily understood terms the primary processes involved in converting iron ore into finished iron and steel products for use in industry. Each chapter is written by an expert or experts in the particular aspect covered. A detailed subject index and numerous illustrations add to the usefulness of the book. Although completely rewritten, the book carries on the purpose of the first and succeeding editions edited by A. O. Backert.

AIRPLANE AERODYNAMICS. By D. O. Dommasch, S. S. Sherby, and T. F. Connolly. Pitman Publishing Corporation, New York, N. Y.; Toronto, Canada; London, England, 1951. Cloth, $6\frac{1}{4} \times 9\frac{3}{4}$ in. 520 pp., illus., diagrams, charts, tables, $6.50. Designed for students having a background in college physics, mathematics, calculus, mechanics, and dynamics, this book is devoted to the "how" and "why" of modern aerodynamics. Emphasis is placed on high-speed flight and on modern developments. Considerable space is devoted to fundamental principles of fluid mechanics and dynamics and to a detailed discussion of the stability and control of aircraft. Numerous illustrative examples and unworked problems are included with answers to many of the problems.

APPLIED NUCLEAR PHYSICS. By E. C. Pollard and W. L. Davidson. Second edition. John Wiley & Sons, Inc., New York, N. Y., Chapman & Hall, Ltd., London, England, 1951. Linen, $6 \times 9\frac{1}{4}$ in., 352 pp., illus., diagrams, charts, tables, $5. The book covers practically all phases of nuclear science including the basic facts of nuclear particles and radiations and methods of accelerating them, transmutation, natural and artificial radioactivity, isotopy, and nuclear fission. In addition to incorporating material covering progress in the field since the first edition in 1942, a new chapter on nuclear chain reactions has been added. Special sections devoted to pile theory, neutron diffraction, cross sections, and cosmic rays are also new. Detailed instructions on laboratory experiments are now included, and the tables of nuclear data are brought up to date.

ASTM STANDARDS ON INDUSTRIAL WATER, prepared by ASTM Committee D-19 on Industrial Water; Sampling Methods, Analytical Methods, Corrosivity Tests, Methods of Reporting, February, 1951. American Society for Testing Materials, Philadelphia, Pa., 1951. Paper, 6×9 in., 160 pp., illus., diagrams, charts, tables, $2. This volume contains the various ASTM standard and tentative methods of sampling, analysis, and testing of water employed industrially in the generation of steam or for process or cooling purposes. The examination of deposits formed from such water is also covered as well as methods of reporting test results. A list of standard definitions of terms and a bibliography of ASTM publications in the field are given.

ANALYTICAL AND APPLIED MECHANICS. By G. R. Clements and L. T. Wilson. Third edition, McGraw-Hill Book Co., Inc., New York, N. Y.; Toronto, Canada; London, England, 1951. Cloth, $6 \times 9\frac{1}{4}$ in., 463 pp., diagrams, tables, $5.50. A working text based on explicitly stated definitions and theorems, this book provides a rigorous discussion of the mathematical and physical theory of mechanics. Significant changes in this third edition include a somewhat briefer treatment of statistics; a greater emphasis on the motion of mass systems, with the plane motion of a rigid body as a special case; a study of mechanical vibrating systems with one degree of freedom and their electrical analogies; and a rearrangement of the material on simple and combined stresses, strains, and deflections in nonrigid bodies.

BEHAVIOR OF ENGINEERING METALS. By H. W. Gillett. John Wiley & Sons, Inc., New York, N. Y.; Chapman & Hall, Ltd., London, England, 1951. Linen, $6 \times 9\frac{1}{4}$ in., 395 pp., illus., diagrams, charts, tables, $6.50. Designed to help nonmetallurgists who must select metals and alloys for engineering uses, this book discusses the behavior of these materials rather than the theories that seek to explain their behavior. The first six chapters introduce basic concepts of metallurgy. The next nine deal with the behavior of each of the principal commercial metals and alloys; and the remaining chapters are devoted to special considerations that may influence the selection of metals and alloys. Bibliographies appear at the end of most of the chapters.

CHROMIUM PLATING. By E. S. Richards. Third edition, revised, and enlarged. Charles Griffin & Company, Ltd., London, England, 1950. Fabrikoid, $5\frac{1}{2} \times 8\frac{1}{4}$ in., 154 pp., illus., diagrams, tables, 17s. Intended for use by those acquainted with the process of chromium plating, this book deals with the practical production of the deposit and the best methods of insuring regular outputs of the highest class. Chemical and theoretical considerations are not given a great deal of space, since the emphasis is on the practical side of plating.

CRITICAL REQUIREMENTS FOR RESEARCH PERSONNEL, March, 1949, 66 pp. DEVELOPMENT OF A TEST FOR SELECTING RESEARCH PERSONNEL, January, 1950, 33 pp. PROCEDURES FOR EVALUATING RESEARCH PERSONNEL WITH A PERFORMANCE RECORD OF CRITICAL INCIDENTS, June, 1950, 42 pp. American Institute for Research, Pittsburgh, Pa. Paper, $8\frac{1}{2} \times 11$ in., diagrams, charts, and tables. These three reports describe a part of a long-range program concerned with research in the effective utilization of scientific personnel. The first is devoted to a study of observed behaviors of personnel in research laboratories and provides a list of critical requirements for research personnel. The second is concerned with the development of a test for selecting research personnel; and the third, with procedures for evaluating research personnel on the basis of a performance record.

DIE CASTING. By H. H. Doehler. McGraw-Hill Book Co., Inc., New York, N. Y.; Toronto, Canada; London, England, 1951. Cloth, $6 \times 9\frac{1}{4}$ in., 502 pp., illus., diagrams, charts, tables, $8. Of interest to metallurgists, equipment and product designers, production engineers, and students, this book discusses the present-day production methods and the design techniques of the entire field of die casting. It describes the components and operations of the various types of die-casting equipment as well as every aspect of die construction and the requirements, composition, and applications of die steels and die-casting alloys. Also covered are the estimation of die-casting costs and safety in the die-casting plant. A final chapter supplies a glossary of terms.

DIE DESIGN AND DIEMAKING PRACTICE. Edited by F. D. Jones. Third edition. The Industrial Press, New York, N. Y., Machinery Publishing Co., Ltd., Brighton, 1, England, 1951. Cloth, $6 \times 9\frac{1}{4}$ in., 1014 pp., illus., diagrams, charts, tables, $7. This treatise for die designers and diemakers contains illustrated descriptions of a large variety of selected dies for all kinds of power-press operations. Practical information and data on approved designing practice and die construction are provided. The third edition contains five new chapters, an expanded cross index, and a detailed table of contents. The new chapters treat special aspects of sheet-metalworking dies and designing of dies for powdered-metal parts.

DIESEL-ELECTRIC LOCOMOTIVE HANDBOOK—Electrical Equipment. 290 pp. DIESEL-ELECTRIC LOCOMOTIVE HANDBOOK—Mechanical Equipment. 262 pp. By G. F. McGowan. Simmons-Boardman Publishing Corporation, New York, N. Y., 1951. Fabrikoid, $5\frac{1}{2} \times 8\frac{1}{4}$ in., illus., diagrams, charts, tables, $4.95 each. Basic reference books for enginemen, maintenance men, and other railroad personnel engaged in operating and maintaining Diesel-electric locomotives, these books provide a survey of the theory and equipment used in this field. As indicated, one deals with aspects of electrical equipment and the other with aspects of mechanical equipment. Direct information is given on the products of the major manufacturers.

DYNAMIC MOTION AND TIME STUDY. By J. J. Gillespie. Chemical Publishing Co., Brooklyn, N. Y., 1951. Cloth, $5\frac{1}{2} \times 8\frac{3}{4}$ in., 140 pp., illus., diagrams, charts, tables, $3.75. Relating work activity to work psychology, this book offers a solution to the problem of increasing efficiency without evoking the antagonism of the operator. Principles of motion study are included which provide a dynamic technique of motion simplification. A list of references is included at the end of the book.

ELASTICITY. (Proceedings of Symposia in Applied Mathematics of the American Mathematical Society, Volume 3.) Published by McGraw-Hill Book Co., Inc., New York, N. Y.; Toronto, Canada; London, England, 1950. Cloth, 7 × 10¼ in., 233 pp., diagrams, charts, tables, $6. This symposium of 17 papers, cosponsored by the Applied Mechanics Division of The American Society of Mechanical Engineers, covers a selection of recent developments in mathematical theory and applications of elasticity and plasticity. Topics such as extensions of approximation methods and general theory of elastic and plastic deformation are thoroughly covered, as well as new applications of the elastic theory of structural members and new methods of stress analysis in elastic and elastic-plastic structures. Lists of references accompany the papers.

ELEMENTS OF TRANSPORTATION ECONOMICS. By G. L. Wilson Simmons-Boardman Publishing Corporation, New York, N. Y., 1950. Linen, 5 × 7¾ in., 178 pp., diagrams, tables, $2.95. This introduction to the subject of transportation economics describes the role of transportation in relation to prices, industrial production, agricultural development, and marketing. The transportation system of the United States is outlined, and one chapter is specially devoted to the railroad organization. Selected references are placed at the end of each chapter.

ENGINEERING MECHANICS. By S. Timoshenko and D. H. Young. Third edition. McGraw-Hill Book Co., Inc., New York, N. Y.; Toronto, Canada; London, England, 1951. Cloth, 6 × 9¼ in., 517 pp., diagrams, charts, tables, $5.50. This text on mechanics aims to acquaint the student with as many general methods of attack as possible, and to illustrate the application of these methods to practical engineering problems. In this third edition, the chief aim has been an improvement in the lists of unsolved problems. These problems serve the twofold purpose of presenting new material not included in the text proper and of providing an example for the student in the logical methods of approach to the solution of engineering problems.

GALVANIZING (HOT-DIP). By H. Bablik, translated by C. A. Bentley. Third edition. E. & F. N. Spon, Ltd., London, 1950. Cloth, 5½ × 8½ in., 502 pp., illus., diagrams, charts, tables, 70s. The first third of this standard work deals successively with the characteristics of scale, pickling theory and practice, and fluxes. The remainder of the book provides a detailed treatment of galvanizing theory and practice. Diagrams and photographs are used extensively to illustrate the practical aspects of the operations covered.

INDUSTRIAL GAS TURBINE. (Technical Trends Series.) By E. C. Roberson. Temple Press, Ltd., London, England, 1951. Linen, 5 × 7½ in., 162 pp., illus., diagrams, tables, 8s, 6d. This book provides students, as well as engineers and technicians in allied industries, with a brief outline of the present state of development in the gas turbine, an indication of its potentialities as a prime mover in the field of power generation, and an outline of the directions in which development is likely to take place. A brief bibliography lists outstanding works in this field.

INTRODUCTION TO SERVOMECHANISMS. By A. Porter. John Wiley & Sons, Inc., New York, N. Y.; Methuen & Co., Ltd., London, England, 1950. Linen, 4¼ × 6¾ in., 154 pp., diagrams, charts, tables, $1.75. Intended for the physicist and engineer who are interested in the subject, this book defines the term "servomechanism" and indicates in terms of elementary examples the theoretical foundations of the subject. Particular emphasis is placed on the basic problems of servo design, namely, those of insuring adequate damping and small dynamic lags. Illustrative diagrams are used extensively as a graphic supplement to the mathematical analysis.

KÄLTEMASCHINENÖLE. By H. Steinle. Springer-Verlag, Berlin, Göttingen, Heidelberg, Germany, 1950. Paper 6 × 9 in., 146 pp., illus., diagrams, charts, tables, 12 Dm. Serving as a reference for engineers interested in the lubrication of refrigerating machinery, this book discusses the problem from the viewpoints of the oil industry and the manufacturers of refrigerating machinery. It also includes testing procedures which help in the selection of natural and synthetic oils. Emphasis is placed on the engineering properties of oils and their effects on the operating characteristics of refrigerating machinery.

MECHANICAL ENGINEERS' HANDBOOK. Edited by L. S. Marks. Fifth edition. McGraw-Hill Book Company, Inc., New York, N. Y.; Toronto, Canada; London, England, 1951. Fabricoid, 6 × 9¼ in., 2236 pp., diagrams, charts, tables, $15.00. Covering the entire field of mechanical engineering, this standard handbook treats fundamental theory and supplies data on the properties of materials and on the performance and characteristics of machinery, structures, and processes. Among the new or greatly modified items are the following: atomic power, gas turbines, jet propulsion, transonic and supersonic aerodynamics, solar energy for heating high-vacuum pumps, radar, and television. The rest of the book has received the customary thorough revision to correspond with current practice.

METAL CLEANING BIBLIOGRAPHICAL ABSTRACTS, 1950 Supplement (Special Technical Publication No. 90-A), prepared by J. C. Harris. American Society for Testing Materials, Philadelphia, Pa., 1950. Paper, 6 × 9 in., 27 pp., tables, $1; when ordered together, the Bibliography and Supplement are $3. Covering a wide range of subject matter, this bibliography should be of value to all those concerned with metals and their surface conditions and cleaning. This supplement to the Metal Cleaning Bibliographical Abstracts (1893–1949) contains 170 annotated references, including 89 additional references for 1932 to 1948, and 81 new references for 1949 and 1950.

NOTIONS DE CHAUFFAGE INDUSTRIEL, Fours et Gazogènes. By M. Choisy. Editions Eyrolles, Paris, 1950. Paper, 6½ × 10 in., 286 pp., illus., diagrams, charts, tables, 1450 fr. A general consideration of the essential phenomena which govern the problems of industrial-heating processes. The several chapters deal respectively with: combustion theory; gas producers; heat utilization; the circulation of heated gases; solid, gaseous, and liquid fuel; refractories and furnace accessories; and with various types of industrial furnaces.

ASME BOILER CODE

Interpretations

THE Boiler Code Committee meets monthly, to consider "Cases" where users have found difficulty in interpreting the Code. These pass through the following procedure: (1) Inquiries are submitted by letter to the Secretary of the Boiler Code Committee, ASME, 29 West 39th Street, New York 18, N. Y.; (2) Copies are distributed to Committee members for study; (3) At the next Committee meeting interpretations are formulated to be submitted to the ASME Board on Codes and Standards, authorized by the Council of the Society to pass upon them; (4) They are submitted to the Board for action; (5) Those approved are sent to the inquirers and are published in MECHANICAL ENGINEERING.

(The following Case Interpretations were formulated at the Committee meeting March 9, 1951, and approved by the Board May 3, 1951.)

CASE No. 994 (REOPENED)*

(Special Ruling)

* Applies to 1949 UPV Code only.

Inquiry: Will unfired pressure vessels fabricated by fusion welding under the general requirements of Pars. U-68, U-69, and U-70 meet the intent of the Code if the base material conforms to the composition of aluminum-manganese alloy M1A of Specification SB-178?

Reply: Aluminum-manganese alloy M1A may be used in the construction of welded unfired pressure vessels in accordance with the general rules of Par. U-68, U-69, or U-70 of the Code with the following limitations:

(1) The material shall conform to one of the following specifications:

Sheet and Plate—SB-178

Tubing—ASTM B-210, B-234, B-235, or B-241, with the addition that the tensile properties shall be not less than the following:

Temper	Tensile Strength, psi	Yield Strength, psi (0.2% offset)
O and F	14000	5000
H-112	14500	6000
H-14	19500	17000
H-18	27000	24000

Shapes—ASTM B-221 with the addition that the tensile properties shall be not less than:

Tensile Strength	14000 psi
Yield Strength (0.2% offset)	5000 psi

(2) Fabrication shall be by fusion welding using electrodes complying with SB-184 or with the chemical requirements of alloy M1A. Either covered or bare electrodes may be used, depending upon the welding process selected. The general rules of Pars. U-68, U-69, or U-70 shall be followed. The spot examination requirements of Par. U-208 shall be met. The acceptance standards for both U-68 and U-69 construction shall be as required for steel construction (see Pars. U-68 and U-208) until such time as acceptable standards are developed and approved for aluminum-alloy welds.

(3) The welding requirements of Section IX and the applicable paragraph apply except that:

(a) the tensile strength of the reduced-section tension specimen shall be not less than 14000 psi.

(b) the elongation as determined by the free-bend test shall be not less than 25 per cent.

(c) qualification tests made on a given thickness of material shall apply to thicknesses varying as much as ±50 per cent from that thickness. Not more than two thicknesses need be qualified, but they shall cover the minimum and the maximum thicknesses under consideration.

(d) in making the guided bend tests, the jig dimensions and the test results shall be in accordance with SB-184.

(4) The following maximum allowable design stresses may be used instead of those given in Table U-3:

Temperature	Up to 100 F	150	200	250	300	350	400
Allowable Design Stress	8000	7750	7500	7200	6000	3300	2200

CASE No. 1120 (REOPENED)

Special Ruling

Inquiry: Is it permissible for welded construction under Sections I and VIII of the Code to use alloy steel plates containing 2¼ per cent Cr and 1 per cent Mo which corresponds to Spec. SA-213, Grade T-22? Spec. SA-213 is a specification for boiler and superheater tubes and there is no ASTM or ASME specification covering this material in the form of plate.

Reply: It is the opinion of the Committee that the intent of the Code will be met by using alloy steel plates which conform to the chemical and physical requirements and allowable stresses of Spec. SA-213, Grade T-22, and which otherwise conform to Spec. SA-301. These alloy steel plates will be classed in "P" Number 5-"O" Number 1 of Table Q-5 in Section IX.

CAUTIONARY NOTE: Because of the different thermal coefficients of expansion of dissimilar materials, caution should be exercised in design and construction when welded with austenitic weld metal in order to avoid difficulties in service under extreme temperature conditions, or with unusual restraint of parts such as may occur at points of stress concentration and also because of metallurgical changes occurring at elevated temperatures.

Metal Temperature not Exceeding, deg F

Temper	100	150	200	250	300	350	400
O and F	3350	3150	2900	2700	2400	2100	1800
H-112*	3600	3250	3000	2800	2500	2200	1900
H-12	4250	4000	3800	3600	3300	3000	2650
H-14	4900	4700	4550	4300	3900	3450	3000
H-18	6750	6400	6050	5700	5250	4400	3500

* For sheet and plate having a nominal thickness not greater than 0.500-in., the design stresses for H-14 material may be used. For plate having a nominal thickness between 0.500 in. and one inch, the design stresses for H-12 material may be used. For tubing and plate thicker than one inch, the design stresses listed shall be used.

(5) For welded joints, the allowable design stresses for the annealed (O) temper shall be used.

(6) The joint efficiency to be used in applying the design rules shall be:

(a) for U-68 construction 90–95 per cent

(b) for U-69 construction 80 per cent

(c) for U-70 construction the ratio of the *SE* values given in Pars. U-70(a) and U-70(b) divided by 11,000.

(7) Thermal stress relieving is not required.

(8) In view of the fact that this material is not one of those which suffer loss of impact resistance at low temperatures, the requirements of Pars. U-140, U-141, and U-142 shall not apply.

(9) In the hydrostatic test, the test pressure shall be not less than 1.5 times the maximum allowable working pressure.

(10) Bolting materials shall conform to alloy CG42A-T4 of ASTM Spec. B-211 or shall be of a suitable corrosion-resistant or coated ferrous material. The allowable design stresses for alloy CG42A-T4 are as follows:

Proposed Revisions and Addenda to Boiler Construction Code

AS need arises, the Boiler Code Committee entertains suggestions for revising its Codes. Revisions approved by the Committee are published here as proposed addenda to the Code to invite criticism. If and as finally approved by the ASME Board on Codes and Standards, and formally adopted by the Council, they are printed in the annual addenda supplements to the Code. Triennially the addenda are incorporated into a new edition of the Code.

In the following the paragraph numbers indicate where the proposed revisions would apply in the various sections of the Code. Simple changes are indicated directly. In the more involved revisions added words are printed in SMALL CAPITALS; deleted words are enclosed in brackets [].

Comments should be addressed to the Secretary of the Boiler Code Committee, ASME, 29 West 39th Street, New York 18, N. Y.

Unfired Pressure Vessels 1950

TABLE UG-23. Under "Plate Steels," "Carbon Steel," opposite specification SA-302, grade B, change the working stresses in the first six temperature columns (650 to 900 incl.) to the following:

20000 20000 20000 19100 16800 13250

PAR. UG-44(a). Delete and substitute:

UG-44(a) *Nozzle Neck Thickness.* The thickness of a nozzle neck shall not be less than the thickness computed for the applicable loadings in Par. UG-22 plus the thickness added for corrosion allowance, but in no case, less than the smallest of the following:

(1) The thickness of a standard-wall pipe (ASA B36.10-1950) plus the design corrosion allowance.

(2) The nominal thickness of the shell as fabricated.

(3) The thickness of extra strong pipe for nozzle sizes up to 12 inches.

PAR. UG-116(m). In first line, change "symbol" to "symbols."

Announcement

A new form P-4A, "Manufacturers' Data Report for Fabricated Piping," to be used for main steam, boiler feed, blow-off or other service piping, is now available.

THE ENGINEERING PROFESSION

News and Notes

As Compiled and Edited by A. F. Bochenek

Western Hemisphere Engineers Set Up Pan-American Union

Engineers Joint Council Represents U. S. Engineers

THE constitution for the Pan-American Union of Engineering Societies (UPADI) was adopted at a constitutional convention held in Havana, Cuba, April 19–22, 1951, and attended by engineers from 19 countries in the Western Hemisphere. The delegates completed the work begun at the first Pan-American Engineering Congress held in Rio de Janeiro, Brazil, in 1949. It was understood that the constitution would serve until the next meeting of UPADI to be held in two or three years when major revisions would be considered. F. Saturnino de Brito is provisional chairman of UPADI.

The purposes of the new federation are to encourage Pan-American conferences and exhibits, to promote individual and collective visits by engineers of member countries, and the interchange of teachers, lecturers, and students among engineering schools, and to encourage industrial standardization.

The following countries were represented at the convention: Argentina, Bolivia, Brazil, Canada, Columbia, Costa Rica, Chile, Cuba, Ecuador, El Salvador, United States, Guatemala, Honduras, Panama, Paraguay, Peru, Puerto Rico, Dominican Republic, Uruguay, and Cuba.

According to the constitution, membership in UPADI is by country. Each country is to be represented by the organization most representative of the engineering profession in that country. Headquarters will be in the offices of the South American Union of Engineering Societies, Montevideo, Uruguay. The federation is to be headed by a nine-man board of directors appointed for a three-year term. One director will be appointed by the engineering society representing each of the following countries: the Argentine, Brazil, Canada, Columbia, Cuba, El Salvador, Honduras, the United States, and Uruguay.

An invitation to hold the next conference in New Orleans, La., was presented for the United States delegation by James M. Todd, president EJC, and was accepted by the conference. Other actions taken at the Havana Conference included setting up a foundation to obtain financial support for principal UPADI activities by contributions from industry, governments, and other sources. UPADI will not have any regular dues or permanent secretariat.

The United States was represented by the Engineers Joint Council whose delegates were: Adolph J. Ackerman, *chairman*, Mem. ASCE, ASME; Gail A. Hathaway, president ASCE; William N. Carey, secretary ASCE; James M. Todd, president EJC; William H. Carson, Mem. ASME; Stewart E. Reimel, Mem. ASME; Titus G. LeClair, president AIEE; Fred Agthe, Mem. AIME; and S. L. Tyler, secretary AIChE. Also present were Harry R. Kessler, vice-president ASME; A. M. Lederer, Mem. NMC; and S. S. Steinberg, Mem. ASCE.

Delegates from The Engineering Institute of Canada were James A. Vance, president, and L. Austin Wright, general secretary.

Thermodynamics Summer School to Be Held at Michigan State

AN Engineering Thermodynamics Summer school, sponsored by the American Society for Engineering Education in co-operation with The American Society of Mechanical Engineers, will be held at Michigan State College, East Lansing, Mich., June 28–July 7, 1951. The school will follow the annual meeting of the ASEE also to be held at Michigan State College.

Registration fee will be $10. It is estimated that room and board for the complete period of the summer school will be approximately $50.

EJC Manpower Commission Issues Three Policy Statements

THE Engineers Joint Council through its Engineering Manpower Commission recently issued three policy statements which (1) deprecated nonengineering assignments for engineers in the Armed Forces; (2) spoke out against proposed legislation extending the top induction age from 26 to 35 for those who have been deferred for occupational reasons; and (3) favored creating civilian reserve deferment boards in each state.

In a letter to George C. Marshall, Secretary of Defense, Carey H. Brown, chairman of the EJC Engineering Manpower Commission, urged that "steps be taken to avoid . . . use of engineering manpower in assignments where engineering training and experience is not required." Mr. Brown said that the EJC was planning to call his attention to specific cases of misuse of engineering manpower to aid him in establishing a general policy and procedure in assigning engineers. Corrective measures in individual cases will also be requested.

The EJC letter noted the apparent lack of an established means of assuring assignment of a trained engineer to duties utilizing such training or to avoid the call of such men to nonengineering assignments. This situation, the Commission felt, harbored a serious danger to defense production. The same information was also sent to Arthur S. Flemming, man-

SOME OF THE DELEGATES TO THE CONSTITUTIONAL CONVENTION OF UPADI HELD IN HAVANA, CUBA, APRIL 19–22, 1951.

[*Front row, left to right:* Manuel J. Puente, (Cuba); Saturnino de Brito filho (Brazil); Gail A. Hathaway, (EJC); Titus G. LeClair, (EJC); and James M. Todd, (EJC). *Second row:* Juan I. Planas Valdés, (Cuba); Luis I. Migone, (Argentina); Gustavo R. Sterling Alvarez, (Cuba); J. A. Vance and L. Austin Wright, (Canada); Adolph J. Ackerman, (EJC); and William N. Carey, (EJC). *Back row:* Justiniano Allende Posse, (Argentina); Juan G. Altoberro, (Uruguay); Federico Boquin, (Honduras); Aron Noremberg, Argentina.]

power assistant of the Office of Defense Mobilization.

Two letters were also sent on April 25, 1951, to Senator Richard B. Russell, chairman, Senate Services Committee, and Representative Carl Vinson, chairman, House Armed Services Committee. In the first, the EJC Commission expressed itself against additional liability for induction beyond the 26-year age limit for men deferred for occupational reasons. Deferment was granted on grounds that a man was essential to the national health, safety, or interest rather than for the convenience of the individual.

In the second letter, EJC stressed the importance to industry of large numbers of engineers holding some form of reserve status. The special training of these men is useful to defense production as well as the military. The decision to recall reserve officers, the Commission said, "should not be made by persons who reflect one category of need primarily," but should be made by a joint civilian and military agency.

The EJC indorsed provisions in proposed legislation, Bill S.1, for civilian reserve deferment appeal boards "to deal with the calling of reservists."

The EJC Engineering Manpower Commission was established in response to a request from the Manpower Office of the National Security Resources Board in September, 1950, to prepare a program "for the most effective utilization of engineers in the national effort and make recommendations as to how such a program could be best administered."

The Commission is made up of three representatives of each of the five societies which comprise the Engineers Joint Council—American Society of Civil Engineers, American Institute of Mining and Metallurgical Engineers, The American Society of Mechanical Engineers, American Institute of Electrical Engineers, American Institute of Chemical Engineers. In addition, three representatives from the American Society for Engineering Education serve on EMC.

Engineering Manpower—What You Can Do About It

EJC Engineering Manpower Commission Suggests:

I IF YOU are a graduate engineer or have had three years of responsible charge of engineering work, and are in the Armed Forces assigned to nonengineering work, take the following steps:

1 Request through your chain of command: (*a*) Assignment to Corps of Engineers; (*b*) classification as special professional personnel; and (*c*) attachment to nearest technical detachment.

2 If your receive no satisfaction, write to EJC Engineering Manpower Commission, 29 West 39th Street, New York 18, N. Y., and provide the following information: (*a*) Record of education; (*b*) record of industrial experience; (*c*) details of present nonengineering assignment; (*d*) date of induction; date of request for engineering assignment; and replies received, if any. (EJC will send these facts to persons in a position to take up your case on an individual basis.)

II IF YOU are an engineer of draft age employed in industry:

1 Notify your employer of your status.

2 Write for a copy of Bulletin No. 1 on deferment procedures and place this in employer's hands.

3 If employer's efforts fail and you are inducted, immediately request through your chain of command: (*a*) Assignment to Corps of Engineers; (*b*) classification as special professional personnel; and (*c*) attachment to nearest technical detachment.

III IF YOU are an engineering student:

1 Remember you have a 30-day postponement of induction after graduation to get a job in the defense industries.

2 Once employed, follow suggestions listed under II.

Defense Production Weekly Announced

THE Defense Production Administration announced recently that it will issue a weekly bulletin entitled "Defense Production Record" to summarize week-by-week developments in defense production. Business firms may get the publication for a subscription rate of $2.50 a year from the Superintendent of Documents, Government Printing Office, Washington, D. C.

U. S. Assumes Leadership in Research

THE United States is currently spending more than five times as much money on technology as it did ten years ago and consequently its research position is the strongest in the world, according to Clyde Williams, Mem. ASME, director, Battelle Memorial Institute, Columbus, Ohio. "In 1940," Dr. Williams said, "industry and government spent $345 million dollars on science and research. In 1951 we are spending at a rate of two billion dollars a year.

In describing what this tremendous research expenditure means to research organizations such as Battelle Institute, Dr. Williams reported that his organization was forced to increase the size of its research plant threefold to keep up with the demands of industry and government for research. The staff was increased from 200 to 1400. New construction soon to be started will quadruple Battelle's World War II research facilities.

Dr. Williams gives no credence to the belief of some that the United States, because of depletion of resources, has reached its industrial peak.

"Alarm over diminishing reserves of some materials is not justified," he stated. "While we should conserve and use to best advantage the resources we have, our economy will not go bankrupt with the failure of any one particular material. Many of our resources are still untapped."

Information on Deferment Procedures Issued by EJC Commission

INFORMATION on deferment procedures was recently published by the Engineers Joint Council through its Engineering Manpower Commission in a bulletin entitled "Utilizing Engineering Manpower."

Known as Bulletin No. 1, the document is essential reading for industrial leaders who are concerned about retaining key personnel of draft age, and for engineering students, engineers in the Armed Forces who may be assigned to nonengineering work, and engineers who are facing induction.

What the EJC Commission has done is to assemble official directives pertaining to engineering manpower and to present this information, along with specific advice, under several convenient headings.

The first section takes up the general problem of selecting and utilizing technical personnel. This is followed by information on the special selective-service procedure pertaining to college students and current college graduates. Here are included the criteria for deferment of college students and Operation Bulletin No. 23 issued on Feb. 9, 1951, by the Director of Selective Service, dealing with reopening classifications of college students.

Engineers who have the responsibility of writing a presentation of appeal to the local selective-service board will find the EJC document especially helpful. Occupational deferment procedures are covered from the point of view of nonreservist engineers and those who are in the reserve officers corps.

The Bulletin points out that employees should not be party to proceedings for their own occupational deferment other than to acquiesce to such action.

Copies of the 10-page bulletin may be obtained from EJC Engineering Manpower Commission, 29 West 39th Street, New York 18, N. Y. Price per copy is 25 cents.

Cornell Honors Thurston and Kimball

TWO laboratories now under construction at Cornell University, Ithaca, N. Y., will bear the names of Robert H. Thurston, first president of The American Society of Mechanical Engineers, and Dexter S. Kimball, president of the Society in 1921, it was announced recently. The buildings are part of a new $1,700,000 center for the study of engineering materials.

The materials-testing laboratory will be named Thurston Hall. The materials processing laboratory will be named Kimball Hall.

Thurston went to Cornell in 1885 from the newly opened Stevens Institute of Technology where he had developed the first four-year course in mechanical engineering. At Cornell he was director of the Sibley College of Mechanical Engineering from 1885 to 1903.

Kimball went to Cornell in 1898 as assistant professor of machine design. He was the first dean of the College of Engineering and served twice as acting president of the University.

National Foundry Center Planned

COLLECTION of funds for a national foundry center to serve as a clearinghouse for the metal-casting industry has been undertaken by the American Foundrymen's Society, it was announced recently. Over $95,000 of a $100,000 goal has been raised by voluntary subscription. Within two years the center will be established on a Midwestern site.

SAM–ASME Time-Study Conference a Success

MANAGEMENT engineers should spend more time selling industrial engineering to three important groups in industry—management, labor, and the general public, if the benefits of their work are to be understood, according to H. B. Maynard, Mem. ASME, president, Methods Engineering Council, Pittsburgh, Pa.

Mr. Maynard spoke at the opening luncheon of the Sixth Annual Time Study and Methods Conference sponsored by the Society for the Advancement of Management and the Management Division of The American Society of Mechanical Engineers. The conference was held at the Hotel Statler, New York, N. Y., April 19-20, 1951.

One of the features of the meeting was the first public exhibition of time-study rating films recently completed by SAM (see page 353 of the April issue of MECHANICAL ENGINEERING).

At another session P. Kay Schwartz, vice-president, Procter & Schwartz, Inc., stated that one year of training in industrial engineering will better equip trainee engineers, salesmen, and supervisors for future responsibility. Such training teaches them the importance of high productivity, lowered costs, and the best way to analyze and evaluate men, machines and their motions.

Ignorance of basic time-study techniques and objectives leads to suspicion and distrust among management and labor personnel, according to J. F. Biggane, chief industrial engineer, Maytag Company. Mr. Biggane reported that supervision and union in his plant want training on time study because they are confused about its aims. The greatest criticism by incentive workers, he said, was the complication of language and arithmetic involved in time study.

As a result of his company's time-study program, both foremen and union representatives are actively trying to assist the operators to understand and accept labor standards.

Speaking on incentive plans, P. J. MacCutcheon, chief industrial engineer, Peter Cailler Kohler Swiss Chocolates Company, said that a good industrial engineer must have the ability to analyze the new and unusual elements of a production operation, group, or department before he can devise a satisfactory incentive plan. It wasn't enough to have the ability to improve methods and to do a competent job of time study. Many incentive plans were indifferent successes, sometimes failures, because the need for tailoring the plan to fit the situation wasn't fully appreciated by the industrial engineer.

ECPD Accelerates Guidance Programs on Local Level

WHILE the Engineers Joint Council through its Engineering Manpower Commission is working for effective utilization of graduate engineers, another joint agency of the engineering profession, the Engineers' Council for Professional Development, is accelerating its student-guidance program to insure that only qualified young men be encouraged to pursue engineering studies.

A reorganized ECPD program was started in April, 1950, with the creation of the Special Committee on Inquiry Into Present Status of Local Guidance Activities. This Committee was composed of one staff representative from the American Society of Civil Engineers, American Institute of Mining and Metallurgical Engineers, The American Society of Mechanical Engineers, American Institute of Electrical Engineers, and the American Institute of Chemical Engineers.

The Committee's first action was to conduct a survey of 450 industrial engineering groups organized on the local level to determine the extent and nature of guidance work being done in their communities.

Returns received from 84 communities indicated that there was a definite need for some kind of co-ordination of guidance procedures and literature used in this field. Returns from communities where a number of national engineering organizations have established local sections showed a vast difference of opinion on what was being done locally, how it was being done, or by whom. Many groups expressed enthusiasm for ECPD leadership, but others indicated that the local group wished not to have outside interference in their guidance activities.

On the basis of the survey by the Special Committee, the ECPD Guidance Committee is now studying the guidance literature being issued by ECPD, Boards of Education, state universities, and other organizations.

The Committee has recently circularized local engineering groups urging them to organize or reanimate their guidance activities. ECPD recently revised its Guidance Manual for Engineers Aiding Young Men Interested in the Engineering Profession. This manual and its companion questionnaire, explains how to organize a guidance committee, how to select its members, how to succeed in working with high- and secondary-school officials, and how to conduct an interview with a high-school student.

Members of the ASME, who wish to serve the profession by contributing services to ECPD guidance work, are requested to write to ECPD Guidance Committee, 29 West 39th Street, New York 18, N. Y.

Interested in Your Schools?

FACTUAL evidence of the nation's critical need for schoolhouse construction was recently published by the Citizens Federal Committee on Education, an advisory group to the Office of Education, currently headed by Ralph L. Goetzenberger, Fellow ASME, and vice-president, Minneapolis-Honeywell Regulator Company, Washington, D. C. Mr. Goetzenberger is representative of Engineer's Council for Professional Development on CFCE. The report, entitled "Citizens Look at Our Schoolhouses," discusses planning, locating of a school, and problems of financing. It should be helpful to engineers interested in local education and those serving on school boards. Copies may be obtained from the Superintendent of Documents, U. S. Printing Office, Washington 25, D. C. Price is 15 cents.

Interest in Unity High

INTEREST in unity of the engineering profession is at a high pitch among Delaware engineers as a result of the report of the Exploratory Group to Consider the Increased Unity of the Engineering Profession and programs to discuss the four proposed plans sponsored by various engineering groups. According to Quentin C. Jurgensen of the Wilmington Subsection of The American Society of Mechanical Engineers, Delaware engineers will be well prepared to take a stand on one of the plans for unification because of discussion meetings sponsored by the ASME, the Delaware Society of Professional Engineers, and the Delaware Engineering Association.

ASME High-Temperature Alloy-Steel Research Progress Reported

NINE electric public utilities and one steamship company are co-operating with The American Society of Mechanical Engineers in a program of research to determine characteristics of alloy steels subjected to action of steam and corrosive gases at high temperatures. The program, which is under the direction of the ASME Research Committee on High-Temperature Steam Generation, is well under way, according to a recent report covering progress from Aug. 1, 1950, to Feb. 28, 1951.

The utilities and the steamship company are making available to the Committee steam generating units burning various fuels. A special test rack holding 14 different unstressed specimen alloys has been placed in each of the units in a part of the furnace where the temperature will reach an average of 1350 F. Six months' exposure is planned in all units except at the Sewaren Station of the Public Service Electric and Gas Company, Sewaren, N. J.

A rack of specimens has also been suspended in a naval boiler for special tests limited to two runs of 100 hrs each, using first a low-sulphur low-vanadium fuel oil, and second, a high-sulphur high-vanadium fuel.

Alloys selected for testing by the ASME Committee are: AISI types 304, 308, 309, 309S, 310, 314, 316, 321, and 347; Illium G, Inconel, Rustless GT-45, Timken 16-25-6, and aluminized low-carbon steel.

Co-Operating Organizations

Co-operating companies are: Philadelphia Electric Company, Philadelphia, Pa.; Moore-McCormack Lines, New York, N. Y.; Commonwealth Edison Company, Chicago, Ill.; Bethlehem Steel Company, Sparrows Point, Md.; The Doe Chemical Company, Midland, Mich.; Pacific Gas and Electric Company, Beaumont, Texas; Pennsylvania Power and Light Company, Allentown, Pa.; Public Service Electric and Gas Company; Standard Oil Development Company, Linden, N. J.; and Union Electric Company of Missouri, St. Louis, Mo.

Prior to making these installations, a prototype rack was subjected to a series of tests in several boiler furnaces at the Picway Station of the Columbus and Southern Ohio Electric Company.

The field test data will show how the selected alloys resist corrosive activity of combustion gases in boiler furnaces of different types fired with a variety of fuels and located in different parts of the country. These data will be compared to the extent possible with tests to be run with the same alloys in laboratory controlled synthetic furnace atmospheres. In the laboratory test program to be conducted at Battelle Memorial Institute, Columbus, Ohio, the specimens will be exposed to six different atmospheres for 1000 hr at 1350 F. Furnace atmospheres will be controlled to maintain high and low concentrations of sulphur, carbon monoxide, and alkaline oxides encountered in boiler-furnace gases.

Oxide Films to Be Studied

Another phase of the ASME research program on which progress is reported is the investigation of the nature, permanence, thickness, and thermal conductivity of the oxide films formed on the internal surface of ferritic and austenitic materials in tubular form. This part of the program will be conducted at Purdue University.

Progress is also reported on the study of metallurgical stability of alloys over periods up to three years. Through the co-operation of the Indiana and Michigan Electric Company of the American Gas and Electric Company System, steam will be available initially at 2050 psig and 1050 F at the Company's Twin Branch Plant, Mishawaka, Ind., and will be further superheated in committee equipment to temperature levels of 1100, 1200, 1350, and 1500 F. The 3-ft 6-in. test lengths of 2-in-OD and 1-in-ID tubing will be removed at intervals of from six to 36 months and subjected to extensive heat-transmission tests at Purdue University and metallurgical studies at the U. S. Naval Engineering Experiment Station, Annapolis, Md.

Prof. H. L. Solberg, School of Mechanical Engineering, Purdue University, Lafayette, Ind., is chairman of the ASME Research Program of High-Temperature Steam Generation.

TEST RACK OF HIGH-TEMPERATURE ALLOY SPECIMENS EXPOSED TO 1350 F FOR THREE MONTHS IN THE SUPERHEATER-TUBE BANK OF A BOILER AT THE SEWAREN STATION OF THE PUBLIC SERVICE ELECTRIC AND GAS COMPANY, SEWAREN, N. J. THE TESTS ARE BEING SPONSORED BY THE ASME RESEARCH COMMITTEE ON HIGH-TEMPERATURE STEAM GENERATION. FULL ANALYSIS OF THIS AND OTHER TEST RACKS WILL BE MADE AT BATTELLE MEMORIAL INSTITUTE, COLUMBUS, OHIO. A FINAL REPORT ON THE TEST-RACK PERFORMANCE IS SCHEDULED FOR THE 1951 ANNUAL MEETING

Fellowships Available

THE Shell Oil Company is extending for another year a series of Fundamental Research Grants totaling $60,000. Shell Fellows receive a stipend of $1200 for the academic year and their tuition and fees are paid. For further information, write to Shell Fellowship Committee, 50 West 50th Street, New York, N. Y.

New Du Pont Program Begun

DAVID L. ARM, Mem. ASME, dean, School of Engineering, University of Delaware, Newark, Del., was recently appointed as the first college educator to serve a year in industry with E. I. du Pont de Nemours and Company. The new du Pont program is designed to help bridge the gap between the campus and industry. Du Pont is giving several educators from engineering schools twelve months' experience throughout its entire engineering organization. Additional appointments are expected to be announced within the next two months.

The educators' salaries, plus reasonable expenses, will be paid by du Pont. It is hoped by providing colleges with an insight into the viewpoints and problems of industry, engineering students may be better prepared to cope with the complexities of modern-day industrial engineering.

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THE ENROLLMENT of engineering students in Canadian Universities is expected to follow the pattern predicted in the United States, according to a survey conducted by the Canadian Department of Labor. Some 2400 engineering graduates are expected in 1951. The numbers for successive years are as follows: 1902 in 1952; 1563 in 1953; and 1649 in 1954. In the United States 25,000 engineering graduates are anticipated in 1952, and 14,000 in 1954, assuming no withdrawals by Selective Service.

London Conference Takes Up Unified Nut and Bolt Dimensions

A GREATER degree of interchangeability in military equipment made in British, Canadian, and American factories was the main objective of a conference held in London recently and attended by industrial and Armed Services delegates from three North Atlantic countries.

According to H. W. Robb, standards engineer, General Electric Company, and chairman of the United States delegation, the conference recommended a basis for standardization of bolt and nut dimensions to supplement work formalized in the signing of the "Declaration of Accord" in 1948 when the three English-speaking countries accepted the principle of a unified screw thread.

The London discussions cleared many obstacles, Mr. Robb said. Details of the recommendations made could not be revealed because the delegates must first report back to standardizing bodies in their own countries for ratification.

Because of the urgent defense requirements, it is practically certain that the recommendations will be confirmed and that manufacturers in the three countries will be working to the unified dimensions.

Armed Forces delegates at the conference were encouraged by the co-operative spirit of industrial delegates of the three countries. Apart from immediate military significance of recommendations adopted, Mr. Robb felt that interchangeability in many industrial products could be expected because of the conference. Already unofficial announcements made by the automotive industries on both sides of the Atlantic indicate that they intend to adopt the unified standard for civilian as well as military production.

In addition to Mr. Robb, American delegates were: *Industry*, R. G. Cummings, Ford Motor Company, Dearborn, Mich.; I. H. Fullmer, National Bureau of Standards, U. S. Department of Commerce, Washington, D. C.; C. L. Harvey, technical director, Lamson and Sessions Company; D. H. Samuelson, chief engineer, The National Screw and Manufacturing Company; D. M. Shackelford, the American Society of Mechanical Engineers; W. C. Stewart, Industrial Fasteners Institute, Cleveland, Ohio.

Armed Forces, E. J. Almquist, U. S. Department of Army (Ordnance), Washington, D. C.; R. F. Bosron, U. S. Air Force; H. B. Bothwell, Design Department, Naval Gun Factory, Bureau of Ordnance, Navy Department, Washington, D. C.; Lieut. Col. D. C. Hine, Army General Staff; J. W. Jenkins, Bureau of Ships, Navy Department; Lt. Col. I. H. Hare, Air Force.

ASME Receives ECA Award

The American Society of Mechanical Engineers was one of some 400 organizations and individuals to receive a Certificate of Cooperation from the Economic Cooperation Administration "for furnishing technical assistance to the peoples of the Marshall Plan countries to aid them in maintaining individual liberty, free institutions, and peace."

Presentations in the New York metropolitan area were made in a ceremony at City Hall, April 19, 1951, at which the Hon. Vincent R. Impellitteri, Mayor of New York, and Egbert White, director, Technical Assistance Program ECA, spoke.

The ASME has been meeting with ECA teams and has been helpful in suggesting itineraries for plant visits.

In announcing the awards William C. Foster, ECA administrator, said that the Technical Assistance Program was helping to make Western Europe strong enough to resist Communist aggression. These countries, he said, were now producing considerably more than they did in prewar years.

Meetings of Other Societies

June 7–8
American Management Association, general management meeting, Waldorf-Astoria Hotel, New York, N. Y.

June 18–22
American Society for Testing Materials, annua meeting, Chalfonte-Haddon Hall, Atlantic City, N. J.

June 25–29
American Institute of Electrical Engineers, summer general meeting, Royal York Hotel, Toronto, Ont., Can.

July 2–4
American Society of Heating and Ventilating Engineers, semi-annual meeting, Multnomah Hotel, Portland, Ore.

(For ASME Calendar of Coming Events see Page 533)

Literature

Heat-Transfer Data

A COMPILATION of basic heat-transfer and flow-friction design data for compact heat-exchanger surfaces, sponsored by the Gas Turbine Power and Heat Transfer Divisions of The American Society of Mechanical Engineers, was recently published in a 74-page booklet entitled, "Gas Turbine Plant Heat Exchangers." Much of the material presented is based upon results of a test program conducted by the U. S. Navy Bureau of Ships at the Naval Engineering Experiment Station, Annapolis, Md.; and work at Stanford University, Stanford, Calif., sponsored by the Office of Naval Research in co-operation with the Bureau of Ships and the Bureau of Aeronautics.

The compilation is the work of W. M. Kays, Jun. ASME, instructor, mechanical engineering, A. L. London, Mem. ASME, professor, mechanical engineering, and D. W. Johnson, Jun. ASME, of Stanford University. The publication contains 15 tables and 65 illustrations. Copies may be obtained from ASME Order Department, 29 West 39th Street, New York 18, N. Y. Price per copy is $3.

Screwed Fittings

AMERICAN Standard Malleable-Iron Screwed Fittings, ASA B16.19–1951, was recently published by The American Society of Mechanical Engineers.

The new American Standard covers minimum requirements for 300-lb malleable-iron screwed fittings in sizes 1/4 to 3 in., inclusive. The standard is based on a document, Standard Practice No. SP-31–1950, prepared by the Manufacturers' Standardization Society of the Valve and Fittings Industry. Copies may be obtained from the ASME Order Department, 29 West 39th Street, New York 18, N. Y. Price per copy is 60 cents.

Nuclear Energy

SECTION VII, Instrumentation, of the proposed American Standard Glossary of Terms in Nuclear Science and Technology was recently issued in a preliminary edition by The American Society of Mechanical Engineers.

This is the fourth in a series of nine pamphlets that will cover nuclear terms in major fields of science and technology. The glossary is sponsored by a conference of 21 scientific societies and agencies organized by the National Research Council in 1948. Section VII consists of 15 pages of definitions and 18 pages of an alphabetical index of terms appearing in all nine of the sections.

Sections of the glossary still in preparation are: I General Terms, II Reactor Theory, IV Chemistry, VIII Isotopes Separation, IX Metallurgy. During 1950 preliminary editions of the following three sections were issued: V Chemical Engineering, VI Biophysics and Radiobiology, and III Reactor Engineering.

Preliminary editions are being issued to make the information in the glossary available promptly and to afford users the opportunity to criticize and suggest revision before the glossary is finally accepted as an American Standard. Price is $1. Order from ASME Order Department, 29 West 39th Street, New York 18, N. Y.

ECPD

A GUIDANCE manual intended for engineers who are aiding young men interested in the engineering profession was recently published by the Engineers' Council for Professional Development, New York, N. Y. The 15-page pamphlet, prepared by the ECPD Guidance Committee, urges members of local engineering societies and sections and chapters of national engineering societies to establish guidance committees to aid high-school

pupils to determine whether they are qualified for careers in engineering.

The manual is supplemented by an appendix, "Shall I Study Engineering?" which is a questionnaire to be filled out by the student for use of the engineer who is advising him. Price of combination is 20 cents.

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A selected bibliography on ceramic engineering listing more than 150 items under 15 classifications was recently published by the Engineers' Council for Professional Development.

The bibliography is Section IV of a seven-part "Selected Bibliography of Engineering Subjects," prepared for the ECPD by the Institute of Ceramic Engineers as a guide to those who wish to continue studies in engineering and allied fields and those who are building their own private libraries. Price per copy is 25 cents.

Order from ECPD, 29 West 39th Street, New York 18, N. Y.

Notes on Coming Meetings

Seven Symposiums Scheduled for ASTM Meeting

SEVEN technical symposiums and many technical papers on a wide range of subjects in the field of engineering materials are on the program of the 54th annual meeting of the American Society for Testing Materials at Chalfonte-Haddon Hall, Atlantic City, N. J., June 18-22, 1951.

This year neither the Exhibit of Testing Apparatus and Related Equipment nor the Photographic Exhibit will be held. These two exhibits are held only every two years.

An important feature of the program will be the 1951 Edgar Marburg Lecture to be given by Frank L. LaQue, international authority on corrosion, and head of the Corrosion Engineering Section, International Nickel Company, who will speak on corrosion testing. Mr. LaQue's talk will include a survey of corrosion testing programs and methods of corrosion testing. He will discuss specifically the difference between the corrodibility of a material and the protective value of its corrosion products and how these are affected by the composition of the material and conditions of exposure.

During the conference there will be an estimated 450 meetings of the various ASTM technical committees. Several of these committees have co-operated in developing the technical symposiums featuring the ASTM program.

Of particular interest to mechanical engineers will be symposiums dealing with ferrous and nonferrous metals, including high-temperature properties and testing, and a separate session dealing with lead and its uses; with other papers on asphalts, cement and concrete, and plastics.

Northwest Resources

"NORTHWEST Resources Mobilized for National Defense and Security" will be the topic of a special one-day public session of the Third Oregon State College Institute of Northwest Resources to be held this summer from June 18 through 30, on the college campus at Corvallis, Ore. The Institute was organized to promote better understanding of the Northwest through knowledge of its resources and how they can be conserved and utilized. This year the Institute will take up balanced utilization and potential development of Northwest resources, and will feature a ten-day field trip through the Columbia Basin area.

The all-day public session will be on June 19 and will include background analyses by outstanding Northwest authorities on agriculture, forestry, water resources, and minerals, a discussion period and a dinner meeting. The session will be free except for the usual dinner charge.

Fee for the two-week Institute, not including the field trip, is $21. For details, write to Prof. J. Granville Jensen, Co-Ordinator, Institute of Northwest Resources, Oregon State College, Corvallis, Ore.

Industrial Research

THE problems of research workers in industry will be explored at the Second Annual Conference on Industrial Research to be held at Columbia University, New York, N. Y., June 11-15, 1951, under the sponsorship of the University's Department of Industrial Engineering. The theme of the conference will be "Personnel and Communications in Industrial Research." As in the past, attendance will be limited to 60 and applications will be accepted in the order received.

People

RALPH E. FLANDERS Hon. Mem. and past-president ASME, U. S. Senator from Vermont, was recently awarded an honorary membership in the American Society of Tool Engineers, at the annual meeting.

* * *

DONALD I. BOHN, chief electrical engineer of the Aluminum Company of America, has been named recipient of the 1950 Benjamin G. Lamme gold medal by the American Institute of Electrical Engineers, "for his pioneering development and application of electrical equipment for controlling rectifying systems in the production of aluminum."

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J. J. DEMUTH, general superintendent, Sligo, Inc., St. Louis, Mo., was elected president of the American Society of Tool Engineers at the 19th annual meeting of the society.

Others elected were: L. B. Bellamy, first vice-president; Roger F. Waindle, second vice-president; T. J. Donovan, Jr., third vice-president; W. A. Thomas, secretary; H. C. McMillen, Treasurer; and H. B. Osborn, Jr., assistant secretary-treasurer.

ALAN T. WATERMAN WAS APPOINTED ON MARCH 21, 1951, DIRECTOR OF THE NATIONAL SCIENCE FOUNDATION, THE GOVERNMENT'S NEWEST AGENCY IN THE FIELD OF BASIC RESEARCH IN PHYSICAL SCIENCES

(Dr. Waterman brings to the foundation a wealth of experience. In the prewar era he was professor of physics; during the war he served the Government in the field of radar and guided missiles and as an administrator responsible for locating qualified scientists for wartime defense projects. In the postwar period he has been responsible for Office of Naval Research's activities in scientific personnel and its budget for basic and applied-research programs. For his defense work he received the Medal of Merit.)

J. ROBERT VAN PELT, mining engineer and research executive of Columbus, Ohio, was named president of the Montana School of Mines, Butte, Mont. Dr. Van Pelt has been identified with engineering education and research, especially in geology and mining, since his graduation from the Michigan College of Mines in 1922.

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ALEXANDER G. CHRISTIE, Hon. Mem. and past-president ASME, professor emeritus of mechanical engineering, Johns Hopkins University, was recently elected a member of the Board of Trustees of the Maryland Commission on Governmental Efficiency and Economy, an independent, nonprofit fact-finding organization.

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IRA P. MACNAB, general manager, Halifax Public Service Commission, was recently inducted as president of The Engineering Institute of Canada.

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GEORGE G. BROWN, University of Michigan faculty member since 1920, has been appointed dean of the college of engineering.

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ARTHUR C. HARTLEY, Mem. ASME, has been elected president of The Institution of Mechanical Engineers.

* * *

CARLTON S. PROCTOR, New York, N. Y., consultant with a long record of professional and civic achievement, was nominated for 1952 president of the American Society of Civil Engineers. Mr. Proctor was a colonel in the Engineers during World War II and decorated with the Legion of Merit.

ASME NEWS

ASME Schedules Two Major Meetings for Month of June

THE American Society of Mechanical Engineers will sponsor two national events this month. Members residing in the Great Lakes area will have an opportunity to participate in the Semi-Annual Meeting which is the second most important meeting sponsored by the Society. In addition to technical events, the Semi-Annual Meeting sets the stage for important administrative decisions. Among these are nominations of officers, and decisions by regional delegates on general topics of interest to the Society.

Members in the Southwest will have an opportunity to participate in a program sponsored by the Oil and Gas Power Division, one of the most active groups within the Society.

There is still time to review the tentative programs and to plan to attend these meetings.

Semi-Annual Meeting in Toronto

On June 11-15 the Society's 1951 Semi-Annual Meeting at Toronto, Canada, will take on an international flavor when The Engineering Institute of Canada sponsors several social events and technical sessions. Other professional organizations who will participate in this meeting are the American Rocket Society and the Institute of Aeronautical Sciences. More than 80 papers will be presented in the 38 technical sessions. For a detailed program, see pages 448-451 of the May issue.

The Right Honorable C. D. Howe, Canadian Minister of the Department of Defense Production, will address the ASME banquet on Wednesday evening, June 13. C. J. Mackenzie, chairman of the National Research Council, in Canada, will deliver the Roy V. Wright Lecture. The lecture was established in 1949 as a memorial to the late Mr. Wright, ASME president in 1931, and is devoted to impressing on engineers the duties and privileges of citizenship in a democracy.

A state senator from New Jersey, Mr. Wright was a publisher and editor of technical journals as well as an eminent engineer. Lecturer on citizenship at the Newark College of Engineering, and co-author with his wife, Eliza G. Wright, of "How to Be a Responsible Citizen," Mr. Wright was a tireless worker in spreading the gospel of citizenship in a democracy.

Another speaker will be Ira P. Macnab, president of The Engineering Institute of Canada, and general manager of the Halifax Public Service Commission. Mr. Macnab will address a joint EIC-ASME luncheon at which Col. Leroy Grant, past-president of EIC, will preside.

The current shortage of engineers and the necessity for their more effective utilization will be an important topic of discussion at the meeting.

Juniors Sponsor Manpower Session

The keynote of the meeting will be sounded by J. Calvin Brown, of Los Angeles, ASME president, at the President's Luncheon on the opening day, Monday, June 11. Carey H. Brown, ASME member, newly elected president of the Engineering Manpower Commission of the Engineers Joint Council, will address a conference of junior members on Monday evening. His topic will be "A Current Plan for Young Engineers."

The training of young graduate engineers in industry will be discussed from the standpoint of an American and a Canadian company in a session sponsored by the ASME Education Committee.

Oil and Gas Power Conference

The second major meeting will be the Oil and Gas Power Division's 23rd annual conference and exhibit to be held at The Baker Hotel, Dallas, Texas, June 25-29, 1951. A feature of the conference will be a special lecture course on "Fundamentals and Practical Aspects of Engine Governing" in which authorities in the field will discuss latest information on engine governing.

In addition to the Diesel exhibit, the program will include social events and plant trips, a feature of which will be an airplane trip to the Halliburton Cement Works to inspect an 8000-hp Diesel installation. The tentative program of this meeting will be found on pages 451-452 of the May issue.

Student Loan Fund

THE Woman's Auxiliary to The American Society of Mechanical Engineers maintains a student loan fund from which students of mechanical engineering enrolled in an accredited college may borrow as much as $300. Applicants must be recommended by the dean of engineering and endorsed by two other responsible persons.

Engineering students interested in the loan should write to Mrs. Franklin H. Fowler, Jr., The American Society of Mechanical Engineers, 29 West 39th Street, New York 18, N. Y.

You Can Afford the 1951 ASME Annual Meeting at Atlantic City

VISITORS STROLLING ON THE BOARDWALK AT ATLANTIC CITY, N. J., WHERE THE ASME 1951 ANNUAL MEETING WILL BE HELD, NOV. 25-30, 1951

(Following the success of the first annual meeting held in Atlantic City in 1947, the policy of holding a meeting outside of New York every fourth year was established. The meeting in Atlantic City is an opportunity to make every dollar work for two—have an exhilarating winter vacation, where the weather is mild and warmed by the Gulf Stream, and keep abreast of the latest developments in mechanical engineering which will be discussed in sessions held at the Chalfonte-Haddon Hall. Atlantic City, a year-round resort, has many fine hotels and excellent restaurants which you may enjoy at off-season prices to suit any budget. Transportation to Atlantic City is as easy as it is to New York. You cannot afford to miss the meeting in Atlantic City in 1951.)

ASME Western Applied Mechanics Meeting Program Announced

THE first western meeting to be sponsored by the Applied Mechanics Division of The American Society of Mechanical Engineers will be held at Stanford University, Stanford, Calif., June 22-23, 1951.

The local committee has arranged for ample housing for members and guests attending the meeting. Dormitory rooms will be available on the Stanford University campus. For reservations, write to E. A. Ripperger, Division of Engineering Mechanics, Stanford University. Rates are $3 for one night, $5.50 for two nights.

The meeting was organized by the following members of the ASME Applied Mechanics Division: R. G. Folsom, chairman; R. Bromberg, J. N. Goodier, and M. S. Plesset.

The committee representing Stanford University is composed of: J. N. Goodier, chairman; R. S. Ayre, A. Phillips, E. A. Ripperger, and D. H. Young.

The laboratories of the Stanford School of Engineering and other places of interest will be open for inspection during the meeting.

The tentative program follows:

FRIDAY, JUNE 22

8:30 a.m.

Registration

9:30 a.m.

Vibrations and Buckling

Vibrations of a Clamped Circular Plate Carrying Concentrated Mass, by *Robert E. Roberson*, Naval Research Laboratory, Applied Mathematics Branch, Washington, D. C.

Lateral Vibrations as Related to Structural Stability, by *Harold Lurie*, Aircraft Division, The Rand Corporation, Santa Monica, Calif.

Internal Friction in Metals, by *Jack L. Alford*, California Institute of Technology, Pasadena, Calif.

2:00 p.m.

Plates and Shells

The Optimum Problem of the Sandwich Plate, by *W. Flugge*, division of engineering mechanics, Stanford University.

On the Inextensional Theory of Deformation of a Right Circular Cylindrical Shell, by *R. M. Hermes*, University of Santa Clara.

Bending of Thin Ring Sector Plates, by *LaMar I. Deverall* and *Charles J. Thorne*, Department of Mathematics and Astronomy, University of Utah.

Experimental Investigation to Determine the Applicability of Elementary Theory for Calculating Deflections of Swept Cantilever Plates, by *H. J. Gunsuhaney* and *H. C. Martin*, department of aeronautical engineering, University of Washington.

SATURDAY, JUNE 23

9:30 a.m.

Vibration, Nonlinear Dynamics

Calculation of Coupled Vibration Modes of Aircraft, by *Michael Dublin*, dynamics staff, Consolidated Vultee Aircraft Corporation, San Diego, Calif.

Nonlinear Motion of a String Induced by a Transverse Force Moving Along Its Length, by *C. R. de Prima* and *F. E. Marble*, dept. of applied mechanics, California Institute of Technology, Pasadena, Calif.

(*a*) **Nonlinear Vibration Problems Treated by the Averaging Method of W. Ritz;** (*b*) **Remarks on Response Curves for Nonlinear Vibrating Systems;** (*c*) **Stability of the Forced Vibrations in a System With Nonlinear Restoring Forces,** by *K. Klotter* and *H. N. Abramson*, division of engineering, mechanics, Stanford University

2:00 p.m.

Plasticity, Creep, Fatigue

The Behavior of Graphite Under Alternating Stress, by *Leon Green Jr.*, atomic energy research department, North American Aviation Inc., Downey, Calif.

Elementary Theory of Creep Buckling of Columns, by *D. Rosenthal* and *H. W. Baer*, department of engineering, University of Calif., Los Angeles, Calif.

A General Method of Calculating the Moment-Strain Diagram in Plastic Bending of Beams, by *Aris Phillips*, division of engineering mechanics, Stanford University.

Unsymmetrical Bending of Rectangular Beams Beyond the Elastic Limit, by *M. S. Aghbabian* and *E. P. Popov*, department of civil engineering, University of Calif.

Boiler Code Committee Meets in New Orleans, May 1

THE Boiler Code Committee of the ASME held its regular May meeting in the Roosevelt Hotel, New Orleans, La., May 1, 1951. The meeting was a feature of the 20th general meeting of the National Board of Boiler and Pressure Vessel Inspectors, held in the same hotel April 29-May 3.

Members of the Boiler Code Committee, many of whom are members of the National Board, participated in sessions of the National Board general meeting which was formally opened on April 30, by James F. Leddy, chairman, National Board, chief mechanical inspector, city of New Orleans, La. According to the Hon. Bernard J. McCloskey, Commissioner of Public Safety, New Orleans was one of the safest cities in the world because it has incorporated the ASME Boiler Code in its building code, has initiated a safety education program and has a permanent safety council.

The ASME Boiler Code which offers one widely accepted code is a great step forward from the days 30 years ago when many states were independently developing their own boiler safety rules, according to C. O. Meyer, secretary-treasurer of the National Board. He also expressed the hope that the ASME Unfired Pressure Vessel Code revised last year would be acceptable to the petroleum and other industries.

At the same session, Perry R. Cassidy, Babcock and Wilcox Company, called attention to the general rules for selection of specifications for ferritic plates and tubular products for boilers and pressure vessels constructed under ASME codes which were published in the March, 1951, issue of MECHANICAL ENGINEERING, pages 249-252. He urged that members of the National Board consider adoption of these rules.

Harry C. Boardman, Chicago Bridge and Iron Company, in a discussion of the 1950 ASME Unfired Pressure Vessel Code, stated that the new edition reconciled major differences between the API-ASME Code and has brought the codes in harmony. Work was continuing on parts of the ASME code dealing with cast iron, brazing, and nonferrous materials, which are to be incorporated in the next edition.

The National Board of Boilet and Pressure Vessel Inspectors is composed of chief inspectors of states and municipalities in the United States, and the provinces in the Dominion of Canada. It was organized in 1919 to encourage uniformity in administering the Boiler Code and enforcing its rules. The Board has also worked to secure interchangeability between the political subdivisions of the United States and the provinces of Canada.

The ASME Boiler Code has been adopted by 38 states, many municipalities, Hawaii, Puerto Rico, and the Panama Canal Zone, and by all the provinces of Canada. The high regard in which the Code is held by American industry was one of the reasons why the International Organization for Standardization invited the ASME to assume the secretariat of the international boiler-code project.

ASME BOILER CODE COMMITTEE AT ITS MEETING IN NEW ORLEANS, LA., MAY 1

The President's Page

Processing ASME Papers

To ASME Members:

IN MY talks with ASME members, two questions are frequently asked: (1) How does ASME handle its technical papers? and (2) Why does it take so long to publish a paper?

These two question are closely related, because publication is the end of a long chain of events. These events are charted in the pamphlet, "Know Your Society."

Every ASME technical paper is reviewed by one or more of some 40 program-making agencies (Professional Divisions, research, and other committees).

After review, revision, and acceptance, the paper is assigned to a meeting.

The Agency (Division or Committee) which has reviewed a paper also recommends whether it should be published in full or in condensed form.

On the basis of this recommendation the Publications Committee assigns the paper to MECHANICAL ENGINEERING, Transactions, or *Journal of Applied Mechanics* (if it is to be published in full), or to mimeographing (if it is to be published in condensed form). Preprints in type or mimeograph form are then prepared for use in discussions and for sale.

This brief outline shows how presentation and publication of a paper are tied together and how a meeting date controls time schedules.

For example: An Annual Meeting paper is presented about December 1. Preprints for discussion purposes should be ready early in November. Because it takes 4 to 8 weeks to edit, set in type, proofread, and print the average technical paper, the manuscript should be in the Editorial Department by September 1. But review, revision, and assignment to a program require at least 30 days, which means that the author must submit his paper in July.

If four or five months elapse between the writing and presentation of a paper, how many more will pass before it is published?

An interval of 30 days after presentation at a meeting is necessary for the preparation of written discussion.

The discussion is set in type, proofread by each discusser, and sent to the author, who then prepares a closure. The closure is then set in type and proofread by the author. Publication may then be scheduled. If discussers and author work promptly, the paper may appear in Transactions as soon as three months after presentation—nearly a year after it was written.

Many members think the interval between writing and publication of a paper is too long. How can we shorten it? We want the divisions to review papers. We want preprints. We want papers and discussion published together. We cannot review, preprint, and publish a paper with discussion all at the same time. One step must follow the other. Each step takes time. The meeting date is the controlling factor.

J. CALVIN BROWN, *President*, ASME

ASME Region VIII Holds Second Annual Meeting

KANSAS CITY, Mo., was the scene of the second annual meeting of Region VIII of The American Society of Mechanical Engineers. The meeting was held April 15–18, 1951, concurrently with the 1951 Student Branch Conference of Northern Tier schools of ASME Region VIII. Six colleges were represented at the conference which included a papers competition and social program. Two papers from each of the participating colleges were entered in the papers competition.

The meeting was opened formally with an address of welcome by N. T. Veatch, Black & Veatch, Kansas City. Speaker at the opening session was Carl J. Eckhardt, vice-president, ASME Region VIII.

Varied Technical Program

Papers presented at the technical sessions covered a variety of subjects of interest to mechanical engineers. Forrest Nagler, chief mechanical engineer, Allis Chalmers Manufacturing Company, Milwaukee, Wis., gave a paper entitled, "Challenge to Engineers." He said that the engineer's problems were the problems of mankind, and that his assets were his ability to deal with facts.

C. N. Kimball, president, Midwest Research Institute, Kansas City, Mo., speaking on "Research and Development of Resources," said that it was the responsibility of the engineer "to lead the way in the productive portion of the economic life" in the Midwest.

The technical program included papers on the design of a modern steam-electric station, professional unity and social responsibility of engineers, problems of making carbon black, the Boeing gas turbine, and others.

J. Calvin Brown, president ASME, was the speaker at the joint student-member luncheon April 16. His subject concerned the civic responsibility of engineers.

Students Win Prizes

At the student-member luncheon, awards were presented for five winning student papers. Prof. Linn Helander, head, department of mechanical engineering, Kansas State College, Manhattan, Kan., presented the prizes with the aid of J. Calvin Brown and Carl J. Eckhardt. The students receiving cash prizes were: *First prize*, Keith R. Cossairt, University of Nebraska; *second prize*, G. H. Frieling, University of Kansas; *third prize*, J. E. Olsson, University of Nebraska; *fourth prize*, Lloyd B. Sharpsteen, Kansas State College; and *Old Guard Prize*, Willis D. Gammill, University of Arkansas.

A panel discussion of the problems facing the graduating engineer was held, with both students and members participating. A buffet supper and entertainment were enjoyed by members and their wives on April 16. Toastmaster for the annual banquet, attended by members and wives on April 17, was Carl J. Eckhardt who introduced the speaker of the evening, Harry Darby, former Senator from Kansas.

Inspection trips were made to Owens-Corning Fiberglas plant, Vendo Company, Midwest Research Institute, Linda Hall Library, Lighting Institute and Municipal Auditorium.

The women were entertained with a luncheon-bridge at the Blue Hills Country Club on April 17. A trip was made on the following day to the William Rockhill Nelson Gallery of Art and the Mary Atkins Museum of Fine Arts, followed by a luncheon at the Tea House by the Side of the Road.

Committees

The following committees of Region VIII were responsible for the success of the meeting: *General chairman*, Chester Cotter; vice-chairman and secretary, C. E. Brown; *meetings and papers*, R. P. Hahn; *hotel*, E. M. Bruzelius; *registration*, Newby Miller; *entertainment*, T. C. Cheasley; *inspection trips*, E. L. McDonald; *publicity*, Martin Goland; *finance*, L. T. Mart; *student activities*, C. H. Green; *ladies*, Mrs. T. C. Cheasley.

ASME Looks Ahead to 75th Anniversary Celebration

LOOKING ahead to the 75th anniversary meeting of The American Society of Mechanical Engineers in 1955, the Board on Technology recently appointed a Temporary Planning Committee to determine scope, theme, and program particulars for the meeting.

Members of the Temporary Planning Committee are: A. W. Thorson, chairman, Narberth, Pa.; Alex D. Bailey, past-president and Honorary Member ASME, vice-president, Commonwealth Edison Company, Chicago, Ill.; J. D. Cunningham, past-president ASME, and president, Republic Flow Meters Company, Chicago, Ill.; T. E. Purcell, Fellow ASME and director at large, general superintendent, power stations, Duquesne Light Company, Pittsburgh, Pa.; R. H. Bacon, president, R. H. Bacon & Company, Chicago, Ill.; John Haydock, editor, *Metalworking*, Sutton Publishing Company, Inc., New York, N. Y.; J. M. Lessells, associate professor, mechanical engineering, Massachusetts Institute of Technology, Cambridge, Mass.; and T. R. Olive, associate editor, *Chemical & Metallurgical Engineering*, McGraw-Hill Publishing Company, New York, N. Y.

One of the themes suggested for the meeting is "The Engineers' Contributions to Free Enterprise."

Among the myriad details upon which decisions will have to be made will be finances, Section participation, public-relations program, use of television, commemorative medals, special programs, and choice of personnel to organize and conduct the Diamond Jubilee.

ASME Calendar of Coming Events

June 11–15
YSME Semi-Annual Meeting, Hotel Royal Aork, Toronto, Ont., Can.
(*Final date for submitting papers was Feb. 1, 1951*)

June 22–23
ASME Applied Mechanics West Coast Conference, Stanford University, Stanford, Calif.
(*Submit papers through J. N. Goodier, Division of Engineering Mechanics, Stanford University*)

June 25–29
ASME Oil and Gas Power Division Conference Baker Hotel, Dallas, Texas
(*Final date for submitting papers was Feb. 1, 1951*)

Sept. 10–14
ASME Industrial Instruments and Regulators Division and Instrument Society of America Exhibit and Joint Conference, Houston, Texas
(*Final date for submitting papers was May 1, 1951*)

Sept. 24–26
ASME Petroleum Mechanical Engineering conference, Hotel Mayo, Tulsa, Okla.
(*Final date for submitting papers was May 1, 1951*)

Sept. 25–28
ASME Fall Meeting, Hotel Radisson, Minneapolis, Minn.
(*Final date for submitting papers was May 1, 1951*)

Oct. 11–12
ASME Fuels and AIME Coal Divisions Joint Conference, Hotel Roanoke, Roanoke, Va.
(*Final date for submitting papers was June 1, 1951*)

Nov. 25–30
ASME Annual Meeting, Chalfonte-Haddon Hall, Atlantic City, N. J.
(*Final date for submitting papers—July 1, 1951*)
(*For Meetings of Other Societies see page 528*)

AT THE REGION VIII ANNUAL BANQUET

(*Left to right:* C. E. Davies, Mrs. Harold Grasse, Mrs. Harry Darby, J. A. Keeth, Harry Darby Carl J. Eckhardt, J. Calvin Brown, president ASME; H. Grasse, Mrs. J. A. Keeth, Mrs. Chester Cotter, C. Cotter.)

CYRUS WILLIAM RICE, PRESIDENT, CYRUS WM. RICE AND COMPANY, INC., AND R. E. PETERSON MANAGER, MECHANICS DEPARTMENT, WESTINGHOUSE RESEARCH LABORATORIES, WESTINGHOUSE ELECTRIC CORPORATION, EAST PITTSBURGH, PA., RECEIVING THEIR FELLOW CERTIFICATES FROM T. E. PURCELL, DIRECTOR AT LARGE, ASME, AND GENERAL SUPERINTENDENT-POWER STATIONS, DUQUESNE LIGHT COMPANY, AT FIFTH ANNUAL PITTSBURGH MECHANICAL ENGINEERING CONFERENCE BANQUET, APRIL 19, 1951.

Pittsburgh Section Holds Fifth Annual Conference

MORE than 400 engineers participated in the Fifth Annual Mechanical Engineering Conference held in Pittsburgh, Pa., April 19–20, 1951. The conference was sponsored by the Pittsburgh Section of The American Society of Mechanical Engineers in co-operation with the Pittsburgh chapters of the following societies: American Materials Handling Society, American Society of Heating and Ventilating Engineers, American Society of Lubricating Engineers, American Society of Refrigerating Engineers, National Association of Corrosion Engineers, and the Engineering Society of Western Pennsylvania.

Pres. J. Calvin Brown was the main speaker at the banquet held on Thursday, April 19, which more than 300 members and guests attended. President Brown spoke on "Pioneer Inventions and the Story Behind Them." T. E. Purcell, director at large ASME, presented Fellow certificates to C. W. Rice, president, Cyrus Wm. Rice and Company, Inc., and to R. E. Peterson, manager of mechanics department, Research Laboratories, Westinghouse Electric Corporation, East Pittsburgh, Pa.

One of the high lights of the meeting was a paper by A. J. Liebman, director of research, Dravo Corporation, Pittsburgh, Pa., on "Scientific Value of Surface Preparation and Paint Application for Use of Designers and Engineers."

Mr. Liebman's paper was part of the metal-surfacing session. Other sessions which were well attended were power, lubrication, and heating and ventilating.

On Friday, April 20, 45 members and guests enjoyed a visit to the Pittsburgh plant of the Fisher Body Company at Dravosburg, Pa., where they were taken on an instructive tour through a modern press plant.

Baltimore Host to Process Industries Division

PUBLIC sentiment against industrial air and stream pollution has reached the point where the expense involved to prevent such pollution must be considered by the process-plant owner as the price that society demands of him for permission to operate his plant. This statement was made by A. G. Christie, professor-emeritus of mechanical engineering, Johns Hopkins University, at the Second Annual Conference of the Process Industries Division of The American Society of Mechanical Engineers. The conference was held at Lord Baltimore Hotel, Baltimore, Md., April 17–19, 1951, in co-operation with the ASME Baltimore Section.

The technical program consisted of 14 papers presented at six technical sessions which centered around the theme "Methods of Control of Air and Stream Pollution." Excellent attendance at all sessions indicated that engineers and industries are becoming increasingly aware of their responsibility in the field of pollution. A total registration of 160 was recorded at the conference. The scope of the several papers presented included the legal, economic, and psychological aspects as well as the technical problems of pollution abatement.

The conference received much attention from the Baltimore press. A local radio station arranged for a 15-minute broadcast in which William F. Byrne, consulting engineer of New York, N. Y., and Professor Christie engaged in a question-and-answer type of discussion on pollution abatement.

What industry can do to aid in the prevention of stream pollution was covered in a paper by E. B. Besselievre, chief sanitary engineer, Dorr Company, Stamford, Conn. Mr. Besselievre listed the four steps by which process industries can help health and other authorities engaged in carrying out antipollution programs: (1) co-operate with the local authorities when confronted with a problem; (2) make proper economic studies to produce the desired results at a reasonable cost; (3) study a means of utilizing by-products; and (4) engage competent specialists to solve their problems.

Such a program, he said, would assure satisfaction to local authorities and economy and savings for all.

One of the high lights of the conference was the banquet on Wednesday at which Walter Evans, vice-president, Electronics and X-Ray Divisions, Westinghouse Electric Corporation, spoke on "War, Peace, and Industry," Mr. Evans presented a comparison of the potentialities for waging total war available to the freedom-loving countries of the world and those behind the Iron Curtain. A feature of the banquet was a rebroadcast of the radio program recorded earlier in the day.

More Jobs and Higher Starting Salaries Reported

SEVENTY-FIVE per cent of the senior class which Case Institute of Technology will graduate in June already have received offers of employment, according to an announcement by Arthur E. Bach, director of placement at the Institute. Multiple offers of employment ranging from 2 to 16 jobs have been received by 40 per cent of the class which includes some 300 men.

Graduates of the Department of Engineering Administration have been most in demand, with 80 per cent now offered jobs. Next largest demand is for mechanical engineers and for physicists.

The entire graduating class will be placed with employers by May 1, some 40 days before its graduation, Mr. Bach predicts.

The average salary of the positions being offered to the Case seniors is $300 a month plus. This average is a new high and compares with an average monthly salary of $269 received by seniors a year ago. The range of the salaries offered has been from $275 to $525 per month.

TV Program to Highlight Creative Frontiers

THE American Society of Mechanical Engineers, in co-operation with other engineering and cultural organizations, will contribute to a one-hour TV program to be called "Creative Frontiers" which will highlight achievements of pioneering men and women who are working on new advances in science, industry, and the arts. Each week a different organization of the Advisory Board will be host and will feature a new idea in one of the fields and the man or woman behind it.

The first 40 minutes of the program will tell the human-interest personal story of the pioneer and his work as interpreted by a cast of actors. Following the dramatic interpretation, the true creator will appear with a

trio of prominent men to discuss the idea being presented.

The Advisory Board of "Creative Frontiers," in addition to the ASME, will include: American Institute of Electrical Engineers, American Association for the Advancement of Science, The American Federation of Art, American Society of Civil Engineers, American Institute of Mining and Metallurgical Engineers, American Institute of Chemical Engineers, New York Chapter of the American Institute of Architects, and The Berkshire Music Center.

ASME Standards Workshop

Machine-Tool Elements

SECTIONAL Committee B5 on Standardization of Small Tools and Machine Tool Elements has completed a proposed American standard on Mounting Dimensions of Lubricating and Coolant Pumps for Machine Tools.

Copies of the proposed standard may be obtained from The American Society of Mechanical Engineers which is administrative sponsor of the project. Write to D. M. Shackelford, standards administrator, ASME, 29 West 39th Street, New York 18, N. Y.

Hand Elevators

THE final draft of a revision to Part III of the American Standard Safety Code for Elevators was approved by the Executive Committee at a meeting on Feb. 13, 1951.

Engineering representatives, users, manufacturers, and insurance companies concerned with safety are invited to comment on the draft. Copies may be obtained from ASME Standards Department, 29 West 39th Street, New York 18, N. Y.

Worm Gearing

SINCE the publication of American Standard Design for Fine-Pitch Worm Gearing, ASA B6.9–1950, the following errors have been called to the attention of The American Society of Mechanical Engineers: On page 6, paragraph 11, fifth line, the word "greater" should be changed to "smaller" and in the seventh line, the word "increase" should be changed to "decrease."

Code Revisions

FROM time to time certain actions of the Sectional Committee B31 will be published for the information of interested parties. While these do not constitute formal revision of the Code, they may be utilized in specifications, or otherwise, as representing the considered opinion of the Committee.

Such information and Supplements to the Code will be mailed to any person or company in consideration of $2, check in advance. Send name, address, and remittance to ASME Order Department, 29 West 39th Street, New York 18, N. Y.

Nonmetallic Bearings

AN annotated bibliography on nonmetallic bearings has been prepared by the Engineering Societies Library, 29 West 39th Street, New York 18, N. Y. The bibliography contains 101 selected references to the literature of the past 12 years covering all aspects of nonmetallic bearings such as their manufacture, design, properties, wear, lubrication, performance, testing, and applications, particularly of bearings made of rubber, wood, laminated phenolic plastics, resin-impregnated cotton fabric, micarta, and nylon. Applications discussed are for rolling mills, marine propeller shafts and rudder posts, automatic presses, axle bearings for railroad rolling stocks, and agricultural machines. Price is $2.

Interpretations of Code for Pressure Piping

FROM time to time certain actions of the Sectional Committee B31 will be published for the information of interested parties. While these do not constitute formal revision of the Code, they may be utilized in specifications, or otherwise, as representing the considered opinion of the Committee.

Pending revision of the Code for Pressure Piping, ASA B31.1–1951, the Sectional Committee has recommended that ASME, as sponsor, publish selected interpretations so that industry may take immediate advantage of corresponding proposed revisions. Case 5 is published herewith as interim actions of Sectional Committee B31 on the Code for Pressure Piping that will not constitute a part of the Code until formal action has been taken by the ASME and by the American Standards Association on a revision of the Code.

Case No. 5

Inquiry: In view of the data in the Miller-Heger report, may increased stresses be used under Section I for $1^1/_4$ per cent chromium $^1/_2$ per cent molybdenum material conforming to ASTM Specification A 158 Grade P-11 and comparable forging grades?

Reply: It is the opinion of the Committee that pending a general revision of the stress tables, the following stresses may be used under Section I of the Code for ASTM Specification A 158 Grade P-11 material and comparable forging grades:

Temperature, F	S value, psi
650	12,000
700	12,000
750	12,000
800	12,000
850	11,500
900	10,500
950	8,800
1,000	6,250
1,050	4,400
1,100	3,200

Junior Forum

War as a Subject for Engineering Inquiry[1]

THE first civic responsibility of the engineer . . . . . is the same as the civic responsibility of every other educated citizen, namely, to think. To hear both sides of every public issue and form his own judgment. To insulate himself against propaganda. To refuse to let emotions or inherited prejudices dominate his reason. To be undisturbed at finding himself repeatedly in the minority. To seek to contribute something new in the way of reasoned opinion, rather than accept opinion formulated by self-appointed "leaders" and handed down to the masses from on high.

One vital subject on which practically no scientific thinking is being done, and to which it would seem that the trained minds of engineers might well address themselves, is war. Why have there always been wars? What are the underlying causes of wars? What, if anything, can be done to remove—not the occasions of war—but the deep-down tensions and pressures that finally erupt into war?

One cause of war—overpopulation—is well covered in "The Revolt of the Masses," by the Spanish philosopher José Ortega y Gasset.

Ortega pointed out that for twelve centuries—from the beginning of European history in the sixth century down to the year 1800—the population of Europe stood practically still at 180 million inhabitants. In the single century between 1800 and 1914 Europe's population leaped to 460 million. Millions of human beings who, in earlier centuries, would have been wiped out by war, pestilence, or famine, were preserved; and not only preserved, but taught to read and, in many instances, given the vote. These extra millions, said Ortega, these "masses," would continue to multiply and, with no tradition of political responsibility, no sense of noblesse oblige, would nonetheless, by their very numbers, become the ruling power in the world. Future wars would be more and more wars of the masses—total wars, instead of the earlier centuries' small operations fought for limited objectives. Wars of total destruction and total failure.

We here in the United States are now engaged in making food plentiful and living conditions easier and healthier, "all over the world," which means that we are subsidizing overpopulation in many areas already dangerously overpopulated. Guy Irving Burch, in the latest issue of *Population Bulletin*, points

[1] Excerpts from a talk by Bruce Barton, chairman, Batten, Barton, Durstine and Osborn, Inc., delivered at the Power Division Luncheon, 1950 ASME Annual Meeting, Hotel Statler, Nov. 28, 1950.

out that the world's population is presently jumping at the net rate—births minus deaths—of 66,000 every day. And that "industrially backward countries to which Western medical science has spread have been increasing about twice as fast as the world at large."

This truly alarming multiplication of the world's masses is only one of the deep-down pressures that unite to cause war. But it is one that needs a lot more study; the kind of analytical nonpolitical study that would seem to be most congenial and rewarding to the scientific minds of engineers.

Metropolitan Juniors Hold Papers Contest

M. M. ATALLA, technical staff, Bell Telephone Laboratories, New York, N. Y., won first prize in the papers competition sponsored by the Junior Committee in the ASME Metropolitan Section. His paper was entitled, "Effect of Pressure Gradients on Heat Transfer in a Turbulent Boundary Layer."

Second prize was won by F. A. Devine, mechanical engineer in the plant department, Western Electric Company, New York, N. Y. Mr. Devine's paper was entitled, "The Effect of Throat Design and Fuel Sizing on Fly-Ash Carry-Over With Chain-Grate Stokers."

A paper by A. C. Gilbert entitled, "A Note on the Calculation of Torsional Natural Frequencies of Branch Systems," was given honorable mention. Mr. Gilbert is stress analyst, Piasecki Helicopter Corporation, Jamaica, N. Y.

The prizes consist of a paid-up membership in the ASME for 1952 and a certificate. The Awards Committee consisted of Allan Kraus, Samuel Hyman, and Richard Kates.

Register Now with Your Personnel Service!

THE Engineering Societies Personnel Service, Inc., has many outstanding engineering positions available throughout the United States and for foreign service.

Make your availability known to the office of the Engineering Societies Personnel Service, Inc., nearest to your home. Never before in the 30-year history of the Service has there been greater opportunities for members of the engineering profession in all its branches: mechanical; electrical; civil; mining, and metallurgical, chemical, and naval architecture.

Now is the time to find the opportunity you have been waiting for—but the initial step must be taken by you.

ALFRED H. MEYER,
Executive director

New York
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100 Farnsworth Ave.

Chicago
84 E. Randolph St.

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57 Post Street

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New York
8 West 40th Street

Chicago
84 East Randolph Street

Detroit
100 Farnsworth Avenue

San Francisco
57 Post Street

Men Available[1]

Professor, 66, married, graduate 1911. 30 years head of mechanical-engineering department, University of Philippines. Ten years with six American universities. Varied practical experience during vacation. Shop, design, and allied courses. Desires mild climate. Me-823-511-D-3

Junior Mechanical Engineer, BME, 26, veteran, extra courses in industrial management. One year varied experience as technical writer and draftsman. Wishes position in industrial-engineering field. Me-824.

Mechanical Engineer, 28, BSME, MME, law degree; eight years planning, research, and development, construction, engineering teaching, patents. Strong background in thermodynamics, refrigeration. Veteran, married, children. Position of responsibility and challenge essential. Me-826.

Mechanical Engineer, 23, married, two years' experience erection, operation, testing large power boilers. Desires production or design position with small organization. Prefers small town in northeastern United States. Me-827.

Plant Engineer, 33, married, family mechanical graduate, chemical-plant and plant-services experience. Will consider only management-level positions. Location, immaterial. Me-828.

Positions Available

Industrial-Management Engineer, 35–45, preferably eight to ten years' experience in industry for firm of consulting-management engineers. $7500–$10,000. Eastern Pa. Y-5286.

Plant Engineer, under 45, mechanical graduate, plant-engineering experience, to plan process change, lay out and install production improvements, design laborsaving devices, and aid in general research and development work in glass manufacturing plant. Salary open. W. Va. Y-5289.

Design Engineer, 28–50, graduate, five years' minimum actual design experience, knowledge of machine-shop practice essential; hydraulic and electrical experience desirable, to do design work on materials-handling machines, mainly power-lift trucks. $4500–$5500. N. Y. State. Y-5300.

Mechanical Engineer, graduate preferred, practical experience in woodworking, and able to set up machines, know correct procedures on saw filing and knife grinding, and be able to make jigs, fixtures, and machine-tool attachments. Must have all-round experience in every department of woodworking plants and have ability for time and motion study to set up wage incentives. Tenn. Y-5313.

Industrial Engineer time-study, incentive methods, production-planning, and cost-reduction experience in paper-converting industry for consulting work in specialty box fields. Considerable traveling. $4800, plus bonus participation. Headquarters, New York, N. Y. Y-5318.

Mechanical Supervisor, 35–45, ME degree familiar with standard machine-shop equipment and other machinery such as automatic screw machines, turret lathes, etc. Should have a thorough knowledge of both ferrous and nonferrous metals, at least eight to ten years' machine-design experience, preferably light machinery, and some experience in organization and administration, particularly in the technical and production fields. Will design special machinery to improve rates of production, decrease cost, and make new products. Purchase special and standard machinery with the handling of all contacts of an engineering nature with the machinery vendors. Conn. Y-5324.

Plant Engineer, 35–40, mechanical graduate, with experience on calenders and mills in plastic or rubber plants, to supervise equipment in vinyl-processing plant. $6000. Long Island, N. Y. Y-5336.

Mechanical Engineers, about 40, ME degree, experienced in selection, arrangement, and evaluation of power equipment, preferably in the chemical industry. Must be thoroughly familiar with fuel-fired and waste-heat boilers; boiler fittings, controls, and auxiliaries; heat exchangers—gas, vapor, and liquid; boiler-water internal and external treating; pumps, compressors, and blowers; piping of power equipment; piping, pressure control, and pressure reducing for steam, water, and air. Occasional traveling. N. J. Y-5347.

Machine Designer, 28–40, mechanical graduate. Must be able to make own calculations and computations for automatic machinery, such as printing presses, etc. $5200–$6500. N. J. Y-5367.

Engineers. (*a*) Plant engineer, mechanical graduate or equivalent, ten years' experience in heavy manufacturing industry. Familiar with all phases of electrical and mechanical maintenance and power-plant operation. Able to set up a preventive maintenance program and supervise maintenance crew. $9000–$10,000. (*b*) Industrial engineer, graduate or equivalent, ten years' industrial-engineering experience in heavy assembly. Able to set up and administer a cost-control program, a wage-incentive system, and a training program. $9000–$10,000. Eastern N. Y. State. Y-5371.

Instructor or Professor in industrial engineering, master's degree or better, or BS with industry experience. Opportunity to obtain master's degree. Will teach one or more courses in industrial management, production control, motion and time study, industrial survey reports, engineering economy, job evaluation and wage incentives, cost and production estimating, factory planning, etc. Salary open. Southeast. Y-5374.

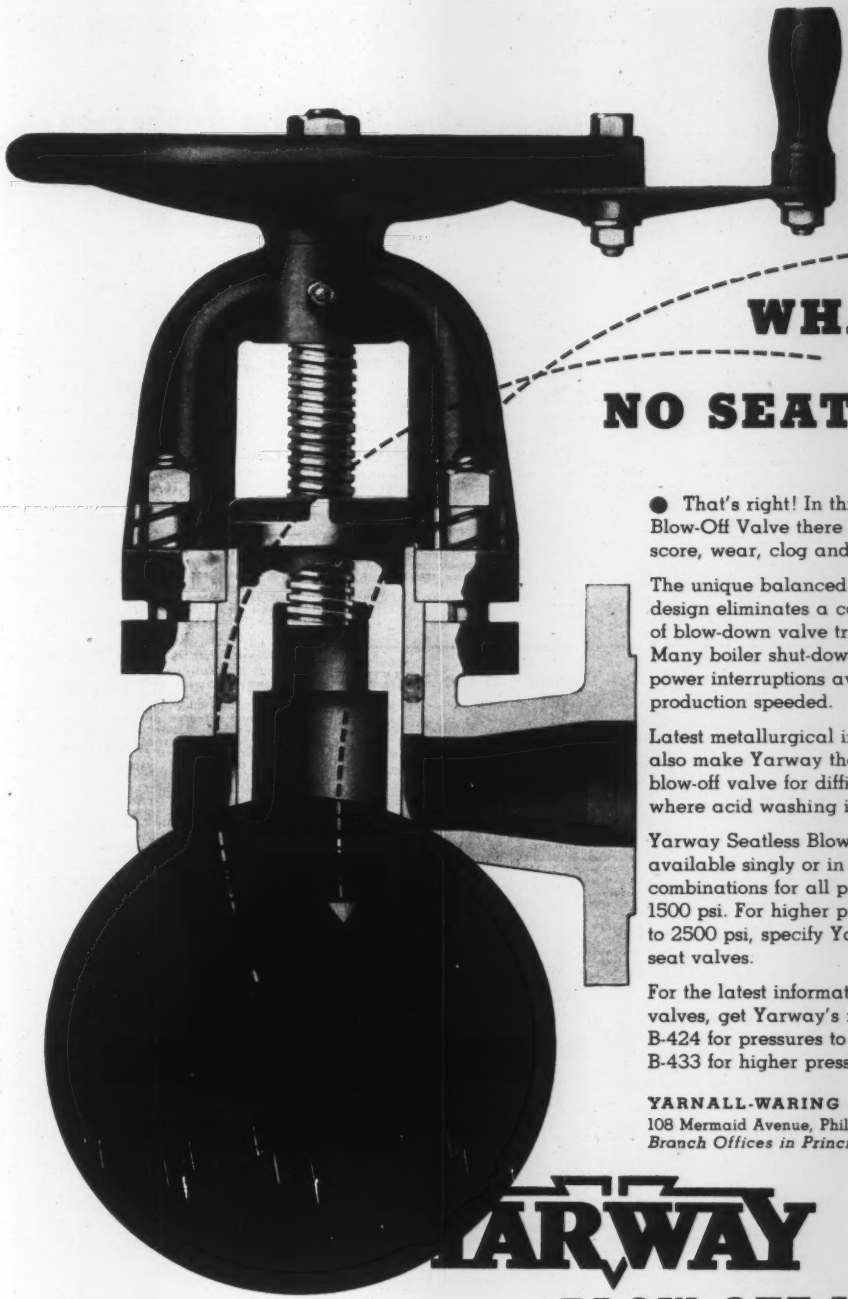
Mechanical Engineer, 28–32, capable of handling men and who has the capacity to manage a business that involves rotary kilns, motors, etc. Must have some experience in burners and general maintenance, and know how to keep records. Salary open. Northwest U. S. Y-5376.

Junior Industrial Engineers some experience, over 25, draft exempt, to assist industrial and commercial firms in developing, installing, and guiding time-study, standards, incentive-plans, methods, plant-layout, plant-maintenance, production-control, and related activities. Traveling involved in N. Y., Conn., N. J., and Pa. $5000–$6500. New York, N. Y. Y-5387.

Rigging Supervisor, mechanical or civil-engineering training and at least five years' machin-

(*ASME News continued on page 538*)

[1] All men listed hold some form of ASME membership.



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The unique balanced sliding plunger design eliminates a common cause of blow-down valve trouble—the seat. Many boiler shut-downs are saved . . . power interruptions avoided . . . production speeded.

Latest metallurgical improvements also make Yarway the ideal blow-off valve for difficult service where acid washing is used.

Yarway Seatless Blow-Off Valves are available singly or in tandem combinations for all pressures up to 1500 psi. For higher pressures up to 2500 psi, specify Yarway Stellite-seat valves.

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BLOW-OFF VALVES

STOP BLOW-DOWN TROUBLES—KEEP BOILERS ON THE

ery, piping, structural, and process-equipment installation and erection experience, to take charge of erection of oil-refining and processing equipment. Some traveling. $7800. New York, N. Y. Y-5391.

Engineers. (*a*) Assistant field engineer, several years' construction experience, to assist construction superintendent on airport project. $7280, plus subsistence. One-year contract. (*b*) Assistant purchasing agent who has had experience on construction materials such as timber, cement, sand, brick, etc. $5980, plus subsistence. One-year contract. Foreign. Y-5392.

Standards-Department Manager, 35–45, will report to works manager. Industrial-engineering degree or equivalent, minimum of five years' experience in manufacturing standards. Supervise five to seven time-study men and specification writers. $6000–$7600. New York, N. Y. Y-5402.

Mechanical Engineer, graduate, who has had machine-shop experience, for engineering planning, follow through of production, writing of manufacturing layouts, etc., for company manufacturing precision parts to close tolerances. Some knowledge of alloy steels desirable; also some experience with heat-treating as company is setting up a new department. Company manufactures precision parts for rolling mills and gear parts for aeronautical industry. About $6000. Conn. Y-5421.

Assistant to President, electrical or mechanical graduate, or equivalent in experience, 38–45, experienced in management controls, government control co-ordination policy, development of procedures, writing and analysis of operating results. Company manufactures ultra-high-frequency testing equipment; employs about 350 people. $12,000. Conn. Y-5425.

Maintenance Manager to take charge of maintenance work and be responsible for the work of about 100 mechanics of various grades. $7200–$8400, depending on experience. Texas. Y-5428.

Project-Plant Engineer, mechanical graduate, 28–35, four or five years' experience in methods and process improvement for heavy process industry. Some knowledge of tools and dies and labor-saving machinery desirable, for multiplant operations. $6000–$7000. New York, N. Y. Y-5430.

Sales Engineer, 30–38, five years' experience, sales and technical background. Knowledge of heating, refrigeration, or air conditioning. Will be branch manager of sales and application of controls for air conditioning, refrigeration, and heating. Some traveling. Car required. $6000–$7000. New York, N. Y. T-7709.

Chief Engineer, mechanical, ten years' experience, design and layout, experienced in internal-combustion engines helpful; able to engage in research and development (product planning and design and new uses). Supervisory experience required. Will supervise drafting, layout, testing and establishment of general standards for an expanding manufacturer of outboard motors. $9000–$12,000. Midwest. R-7641.

Assistant Mechanical Engineer, 27–45, minimum of four or five years' experience involving maintenance, construction, and erecting as encountered in the chemical-process industry; knowledge of planning layouts, cost, estimating, and practical factors required. Will work under chief mechanical engineer and be required to contact mining, chemical, food, and processing plants, principally in the West. $6900–$7200. Headquarters, Ill. R-7726.

Plant Superintendent, over 30, mechanical background, five years' experience in operation and maintenance of driers, conveyers (belt and bucket); informed about hammer mills, loaders. Will supervise 12 people and oversee production for a manufacturer of fertilizer. $5000 and up. Ill. R-7733.

Candidates for Membership and Transfer in the ASME

THE application of each of the candidates listed below is to be voted on after June 25, 1951, provided no objection thereto is made before that date, and provided satisfactory replies have been received from the required number of references. Any member who has either comments or objections should write to the secretary of The American Society of Mechanical Engineers immediately.

KEY TO ABBREVIATIONS

R = Re-election; Rt = Reinstatement; Rt & T = Reinstatement and Transfer to Member.

NEW APPLICATIONS

For Member, Associate, or Junior

ATKINSON, HAROLD C., Wyomissing, Pa.
BASTRESS, E. K., Toledo, Ohio
BAYNES, FREDERICK A., Buffalo, N. Y.
BERG, CHARLES J., JR., New York, N. Y.
BIANCO, GUY R., Horseheads, N. Y.
BIGGERS, JAMES U., Laramie, Wyo.
BOUQUET, R., Exincourt, Doubs, France
BRENNAN, DONALD G., Buffalo, N. Y.
BRUSCHINI, ALBERT, Muncie, Ind.
CANNON, J. P., Tulsa, Okla.
CAREW, W. E., JR., Wilmington, Del.
CENTURY, BERNARD A., East Orange, N. J.
CHASE, BRADFORD A., Foxboro, Mass.
CHRISTOPFERSON, DON L., San Francisco, Calif.
CLARK, JACK E., Park Ridge, Ill.
CONGREVE, RICHARD N., Chicago, Ill.
COOK, ELMO L., Norfolk, Va.
COOKE, DOUGLASS D., Crystal River, Fla.
CUFF, DAVID W., Chepachet, R. I.
DAILEY, J. J., East Peoria, Ill.
DERBY, ELLES M., Ridgewood, N. J.
DONOVAN, W. J., Phillips, Texas
DRESDEN, ANTON, Queens Village, N. Y.
EDGAR, ROBERT B., JR., Cleveland, Ohio (Rt&T)
ELSEVIER, ERNEST, Durham, N. C.
EYSTER, ROBERT M., JR., Springfield, Ill.
FIGG, ALBERT H., Canton, Ohio
FRANKS, JOHN S., San Francisco, Calif.
FRIEDMAN, SIDNEY C., Springfield, Mass. (Rt&T)
GASPEROVICH, ANTHONY L., Moline, Ill.
GREENWOOD, MARVIN H., Houston, Texas
GUNTON, E. H., Des Moines, Iowa
HARRIS, HARRY M., Philadelphia, Pa.
HART, L. E., Wilmington, N. C.
HOSE, ROBERT H., Mountainside, N. J.
HUNTER, GEORGE A., Chattanooga, Tenn.
INMAN, HARRY C., JR., Chattanooga, Tenn.
JEWELL, K. A., Evanston, Ill.
JODREY, ROBERT M., Durham, N. H.
JOHNSON, ALFRED R., JR., Nitro, W. Va.
JOHNSON, EADS, JR., New York, N. Y.
JOST, BERNARD W., Moline, Ill.
KELLY, LOUIS J., Tenafly, N. J.
KITCHENER, L. F., Copper Cliff, Ont., Can.
KLITSCH, WILLIAM C., Ridley Park, Pa.
KU, P. M., Cambridge, Mass.
LAINE, LEO, Ambes, Gironde, France (Rt&T)
LAMADE, HOWARD J., JR., Williamsport, Pa.
LEAVENS, WILLIS H., Wellsville, N. Y.
LILYSTRAND, T. O., JR., Santa Fe, N. Mex.
LUNSFORD, HAROLD D., Huntington, W. Va.
MAHLER, MARTIN, Union, N. J.
MALKIN, GABRIEL, Brooklyn, N. Y.
MASON, JOHN T., Greenville, S. C.
MCCREARY, RICHARD S., Fremont, Ohio
MCDIVITT, DONALD M., Lancaster, Pa.
MCFADDIN, DON E., Los Angeles, Calif.
MCLARTY, COLIN SLATOR, Lancaster, Pa.
MICHENER, WILLIAM J., Lansdowne, Pa.
MURPHY, MALCOM L., JR., Shawnee, Okla.
NEILSON, JAMES E., St. Catharines, Ont., Can. (Rt&T)
NICK, GUS C., Chicago, Ill.
NIKSCH, H. E., Joliet, Ill.
ORPIN, WALLACE B., South Boston, Mass.
PAPPAS, JOHN E., Hillsboro, Ore.
PELKER, REX DENTON, Portland, Ore.
PICKFORD, ARTHUR H., Peoria, Ill.
PRICE, EDWARD P., Lubbock, Texas
PROFITA, GERALD A., New Orleans, La.
RAJAN, K. N., Mallesswaram, Bangalore, India
RAND, CLIFFORD A., East Orange, N. J.
RATCLIFF, PEDRO A. R., Bayside, N. Y.
REID, THOMAS R., Dearborn, Mich.
RITTENHOUSE, EARL G., East Orange, N. J.
ROBINSON, JAMES N., Charleston, S. C.
ROWLANDS, EDWARD W., JR., Massillon, Ohio
RYAN, JOHN M., Long Island City, N. Y.
SAARINEN, ARMAS J., San Carlos, Calif.
SILVER, E. MARSHALL, Montreal, Que., Can.
SMITH, G. C., Hamilton, Ont., Can.
SMITH, LESLIE S., Chattanooga, Tenn.
SNYDER, BRUCE EDWARD, Mahwah, N. J.
SYMANOSKIE, J. V., Washington, D. C.
TORRENCE, JAMES L., Webster Groves, Mo.
TRUITT, GARLAND L., Claymont, Del. (Rt&T)
VANDER WALL, CLIFFORD E., Marinette, Wis.
VIVANCO, RAUL, Mexico, D.F., Mexico
WILLIS, WILLIAM, Upper Montclair, N. J.
WOODNORTH, PAUL T., JR., Chicago, Ill.
ZALIS, ALBERT A., Warren, Mass.

CHANGE IN GRADING

Transfers to Member and Associate

ADILETTA, JOSEPH G., Westbury, N. Y.
CURREN, RALPH L., Staten Island, N. Y.
DUNWOODY, WILLIAM B., Yazoo City, Miss.
FISHER, WILSON HUNT, Concord, N. C.
HOARD, KENNETH S., Gary, Ind.
HOOBER, DANIEL, Washington, D. C.
HUGHES, HUNTER R., Rock Hill, S. C.
HUMPHREY, HOWARD C., New Britain, Conn.
JOHNSON, ALFRED F., North Plainfield, N. J.
KAISER, FRANZ F., Jackson, Mich.
KING, C. F., Marshalltown, Iowa
KOPEC, CASIMIR S. Pittsburgh, Pa.
LEFF, ROBERT CHARLES, Ridgewood, N. J.
LEVINE, BORIS, Washington, D. C.
MACLAY, WILLIAM R., Chicago Heights, Ill.
MAERTIN, HARVEY A., JR., Fremont, Ohio
MIKOVEC, JOHN S., Mason City, Iowa
ODENWELLER, HUGO F., Bethlehem, Pa.
PAVA, NORMAN, Flushing, N. Y.
PERCY, WILLARD E., Diablo Heights, C. Z.
PITTS, DERRELL D., San Diego, Calif.
SAWYER, H. T., Buffalo, N. Y.
THOMAS, WILLIAM B., Port Arthur, Texas
TIPTON, HOBART, Wockford, Ill.
TOMBAUGH, ROY W., El Monte, Calif.
WLODARSKI, JOHN, Hampton, Va.

Transfers from Student Member to Junior . . . 1300

Obituaries

Edward Herbert Angier (1870–1951)

EDWARD H. ANGIER, president, Angier Corp., Framingham, Mass., died Feb. 6, 1951. Born, Akron, Ohio, Jan. 30, 1870. Education, three years, Harvard University. Married Gertrude Clapp, 1897. Assoc. ASME, 1917. Survived by wife and two children, Otis, Clearwater, Fla., and Mrs. Albert J. (Frances A.) Thiel, Wellesley, Mass.

Edwin Salisbury Carman (1879–1951)

EDWIN S. CARMAN, president, Edwin S. Carman, Inc., engineers and foundry consultants, Cleveland, Ohio, died March 20, 1951. Born, Prairie Depot, Ohio, Jan. 3, 1879. Parents, Howard and Minerva Adeline (Bixler) Carman. Education, high school; Cleveland Manual Training School. Married Annie Maye Warren, 1900. Mem. ASME, 1917; Fellow ASME, 1937. President ASME, 1921. He served the Society as first chairman, Cleveland Section, 1918; member, Committee on Aims and Organization and chairman, Subcommittee C; ASME representive on the Joint Conference Committee; on Committee on Constitution and By-Laws; delegate to The Federated American Engineering Societies. He wrote many technical papers, among which was "Foundry Molding Machines and Pattern Equipment." He was internationally known as the designer of the first successful power-operated cylinder molding machine, which he perfected in 1912, and as an authority in molding-machinery engineering, who contributed much toward quantity production of automobiles. Survived by wife and six children, Mrs. Bernice M. Young, Mrs. Esther M. Frye, Mrs. Laura L. Fetzer, Mrs. Doris A. Watt, Thornton S., Mem. ASME, E. Lawrence; and five grandchildren.

Harold Douglas Church (1883–1951)

HAROLD D. CHURCH, retired automotive engineer, died in the Sarasota (Fla.) Hospital, March 11, 1951, after a long illness. Born Waltham, Mass., April 16, 1883. Parents, Duane H. and Harriet L. Church. Education, high-school graduate; attended Massachusetts Institute of Technology. Married Beatrice Springer, 1909, son, Alden D. Mem. ASME, 1913. Author of many papers published in technical journals.

George Henry Hilgartner (1864–1951)

GEORGE H. HILGARTNER, retired mechanical engineer, Export Leaf Tobacco Co., died at Johnson Willis Hospital, Richmond, Va., March 10, 1951. Born, Independence, W. Va., March 20, 1864. Parents, Bathalzar and Elizabeth (Nightingale) Hilgartner. Education, public schools in West Virginia. Married C. Henrietta Ellis, 1894, Mem. ASME, 1913. Survived by wife and two children, Mrs. Carretta E. H. (George R.) Smith, Richmond, Va., and George H., Jr., Louisville, Ky.; three grandchildren and a great-grandchild.

Robert DeVere Hope (1884–1951)

ROBERT DEVERE HOPE, Lieut. Col., U. S. Army, retired; consulting engineer, Fanwood, N. J., died March 23, 1951. Born, Richmond, Va.,

(*ASME News continued on page 540*)

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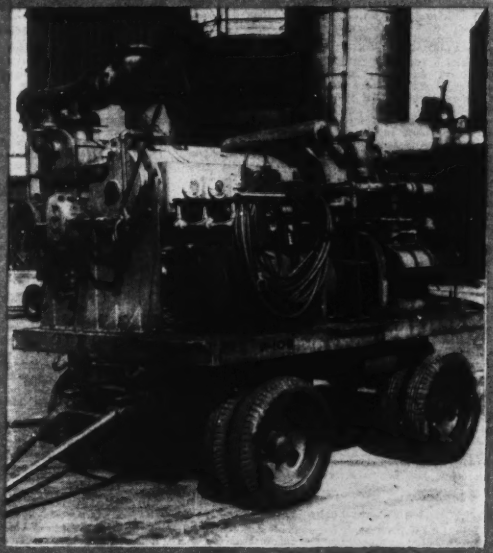
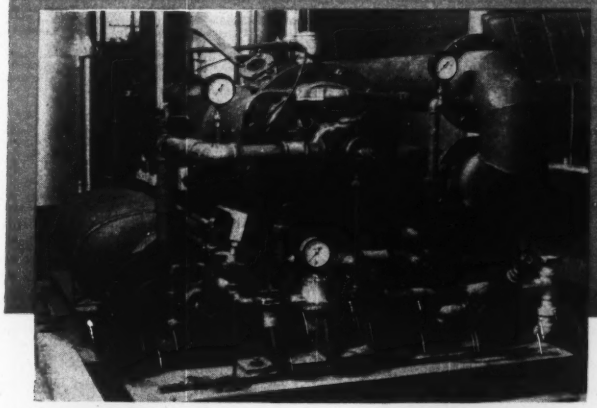


Portable R-C Inert Gas Generator used for purging operations and stand-by protection in large gas-producing plant. Capacity 12,000 cfh.

Installation of these R-C Inert Gas Generators similar to this one helped one large plant save $6,000 per month insurance premiums, as well as substantially reduce danger of production losses caused by explosion or fires. Capacity of each unit, 6,000 cfh.



ROOTS-CONNERSVILLE
BLOWER BUILDERS SINCE 1854
ONE OF THE DRESSER INDUSTRIES

Jan. 18, 1884. Parents, R. DeVere and Francis E. (Gates) Hope. Education, graduate, Virginia Polytechnic Institute; EE, Polytechnic Institute of Brooklyn, 1907. Married Lilian N. Betts, 1907. Mem. ASME, 1930. Survived by wife, two daughters, Mrs. Virginia Hope Powell and Mrs. Genevieve Gagnebin; and four grandchildren. He was buried at Arlington (Va.) National Cemetery.

Charles Lukens Huston (1856–1951)

CHARLES L. HUSTON, first vice-president, Lukens Steel Co., Coatesville, Pa., since 1925 and for which he has worked since 1875, died March 14, 1951. Born, Coatesville, Pa., July 8, 1856. Parents, Charles and Isabella Pennock (Lukens) Huston. Education, AB, Haverford College, 1875. Married Annie Stewart, 1895. Assoc. ASME, 1887. He served on the ASME Boiler Code Committee since 1910. He was the only living American who was an honorary member of the British Iron and Steel Institute. A contemporary of Andrew Carnegie, John Fritz, and Charles M. Schwab, he played an important part in the development of the American steel industry.

He was the patentee of several highly regarded inventions used in the manufacture of steel, and he planned and designed Lukens four-high 206-in. mill, the world's largest plate mill. It was the first four-high mill ever built. He was also largely responsible for the installation of the first head-spinning machine at Lukens in 1885. He wrote many technical papers of importance. He was active in the civic and religious life of his community. Survived by wife, two sons, Charles L., Jr., and Stewart; a daughter, Ruth; and three grandchildren.

Rodney Roach James (1926–1950)

RODNEY R. JAMES, Ensign, U. S. N., died in an accident at Cabaniss Field, Corpus Christi, Texas, Oct. 10, 1950. Born, Boulder, Colo. Parents, Mr. and Mrs. Lloyd S. James. Education, BS, U. S. Naval Academy, 1949. Jun. ASME, 1949. Survived by parents and sister, Diane.

Frederick Sawtelle Jones (1892–1951)

FREDERICK S. JONES, staff consulting engineer, Socony-Vacuum Oil Co., Inc., New York, N. Y., died Feb. 26, 1951. Born, Augusta, Me., July 6, 1892. Parents, Charles W. and Sarah Pauline Jones. Education, BSEE, University of Maine, 1914. Married Elsie Gorse, 1920; children, Frederick S., Jr., Marilyn E. Mem. ASME, 1943.

Charles Edward Lucke (1876–1951)

CHARLES E. LUCKE, Stevens professor emeritus of mechanical engineering, Columbia University, consulting engineer, and expert on internal-combustion engines, died March 25, 1951. Born, New York, N. Y., June 20, 1876. Parents, John Franklin and Sarah Frances (McGrury) Lucke. Education, BS, College of the City of New York, 1895; MS, New York University, 1899; PhD, Columbia University, 1902; hon. ScD, 1929. Married Ida Marguerite Becker, 1904. Assoc. ASME, 1903; Mem. ASME, 1908; Fellow ASME, 1938. He served on several ASME committees and was honored at a luncheon during the 1946 Annual Meeting for his work as one of the founders of the ASME Heat Transfer Division. He was author of "Gas Engine Design," "Power," "Engineering Thermodynamics," "Heat Transfer Processes and Apparatus," and more than 150 technical papers. He held more than 100 U. S. Patents. Survived by wife and two sons, Charles E., Jr., Queenstown, Md., and John, a professor at the University of Connecticut.

William Edwin Mathews (1865–1950)

WILLIAM E. MATHEWS, retired design engineer, Air and Gas Compressor Division, Hardie-Tynes Manufacturing Co., Birmingham, Ala., died Dec. 19, 1950. Born, New York, N. Y., March 15, 1865. Parents, Ferdinand Schuyler and Frances (Coffin) Mathews. Education, Brooklyn Collegiate and Polytechnic Institute. Married Harriet Newell Ingell, 1900 (died 1945). Mem. ASME, 1895. Survived by son, Richard I., Honolulu, Hawaii, and daughter, Mrs. Eleanor M. (F. E.) Arn, Birmingham, Ala.

Charles Adriance Mead (1870–1951)

CHARLES A. MEAD, consulting engineer, Upper Montclair, N. J., died March 28, 1951. Born, Tuckahoe, N. Y., April 1, 1870. Parents, Gideon H. and Frances S. (Adriance) Mead. Education, Pratt Institute. Married Isabella H. Boyd, 1893. Mem. ASME, 1913. He belonged to several engineering and patriotic societies.

He designed and built many New Jersey highways, bridges, and power stations; he worked on engineering projects in the Philippines, Argentina, Brazil, and Mexico. Survived by wife; two daughters, Mrs. Bessie Boyd, Mrs. Alice Cleland; a son, George A.; three grandchildren; and a great-grandchild.

James Weston Moore (1889–1951)

JAMES W. MOORE, manager, Special Products Division, American Cast Iron Pipe Co., Birmingham, Ala., died March 3, 1951. Born, Hickory, N. C., Aug. 8, 1889. Parents, James Thomas and Annie (Brown) Moore. Education, BSEE, Alabama Polytechnic Institute, 1909; EE, 1915. Married Jessie Floyd, 1913; children, Jane Elizabeth, James W., Jr. Assoc. Mem. ASME, 1917; Mem. ASME, 1922.

Inventor and patentee of cupola-charging machines, improvements in centrifugal-casting machines, pipe joints and packing for pipe joints, and stuffing boxes.

Herman Foster Reynolds (1893–1950)

HERMAN F. REYNOLDS, mechanical designer, Philadelphia (Pa.) Electric Co., died July 18, 1950. Born, Rising Sun, Md., Dec. 28, 1893. Parents, John Haines and Mabel (Wilson) Reynolds. Education, diploma in mechanical engineering, Drexel Institute of Technology, 1916. Married Nellie H. Moore, 1919. Mem. ASME, 1945. Survived by wife and daughter, Mrs. Elinor R. Alger, Arlington, Va.

Leslie Earl Sebald (1894–1951)

LESLIE E. SEBALD, vice-president—engineering, Griscom-Russell Co., New York, N. Y., died March 5, 1951. Born, Milwaukee, Wis., Sept. 28, 1894. Education, graduate, Baltimore Polytechnic Institute, 1913. Married Edith M. Dawes, 1917. Jun. ASME, 1919; Assoc-Mem. ASME, 1925; Mem. ASME, 1935. Survived by wife and two children, Leslie E., Jr., and Dorothy.

Harry James Smith (1881–1951)

HARRY JAMES SMITH, retired construction engineer, gas department, Pacific Gas and Electric Co., San Francisco, Calif., died Feb. 24, 1951. Born, San Francisco, Calif., March 8, 1881. Parents, Peter Asmus and Christina Maria (Peterson) Smith. Education, private instruction in engineering under Professor Klink, San Francisco, Calif., 1900–1905. Married Mary Viola McNeil, 1905. Mem. ASME, 1921. Polyflo, a flow computer, was invented by H. J. Smith and B. C. Shebeko. Survived by wife and daughter, Florence Alice.

Joseph Augustus Ward, Jr. (1925–1951)

JOSEPH A. WARD, JR., sales engineer, Abbott, Lester and Co., Inc., New York, N. Y., died Feb. 6, 1951, in a train wreck at Woodbridge, N. J. Born, Paterson, N. J., June 13, 1925. Parents, Joseph Augustus and Ruth (Scripture) Ward. Education, BS, Swarthmore College, 1945; Columbia University Midshipmen's School, 1945; MS, Columbia University, 1950. Married Evelyn Inman, 1948. Jun. ASME, 1945. Survived by wife and daughter, Jane A.; his parents and sister, Mrs. Bentley Wickham, New Brunswick, N. J.

William Watson, Sr. (1869–1951)

WILLIAM WATSON, SR., former vice-president in charge of manufacturing, Allis-Chalmers Manufacturing Co., Milwaukee, Wis., died March 13, 1951. Born, Rockford, Ill., Jan. 6, 1869. Parents, William and Sarah (McMillan) Watson. Education, public schools. Married Belle Davis, 1901 (died 1929). Mem. ASME, 1920. Survived by a daughter, Mrs. Eleanor (F. A.) Sanlader, West Allis, Wis., and two sons, William E., Milwaukee, Wis., and Willard D., Springfield, Ill.

George Roemer Woods (1887–1951)

GEORGE R. WOODS, president, R. S. Stokvis and Sons, Inc., New York, N. Y., importers and exporters of oil-well machinery and tools, died March 21, 1951. Born, New York, N. Y., Feb. 13, 1887. Parents, Thomas and Clara (Roemer) Woods.

Education, LLB, New York Law School, 1913. Married Eunice Gates, 1924. Jun. ASME, 1916; Mem. ASME, 1925. Survived by wife and two sons, Gurdon R. and Dennison G.

ASME Master-File Information

(Not for use of student members)

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Name of employer .....

Address of employer ..... ☐ (Street — City — Zone — State)

Product or service of company .....

Title of position held .....

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HEADQUARTERS depends on its master membership file for answers to hundreds of inquiries daily pertaining to its members. All other Society records and files are kept up to date through changes processed through it. The listings in future ASME Membership Lists will be taken directly from the master file. It is important to you that it lists your latest mailing address and your current business connection.

Four weeks are required for complete processing of address changes.

The mailing form on this page is published for your convenience. You are urged to use it in reporting recent changes.

Your mailing address is important to Headquarters. Please check whether you want your mail sent to home or office address.

To help you get the most out of the steels you're getting

The rearmament program is packed with headaches for steel users. And that is true whether you are working on defense orders or on non-military requirements.

If **you are working on defense materials you will of course get first call on critical steels. The steels you need for government defense orders will somehow be made available, but — you will still be faced with the necessity of quickly making the most out of those steels. For military needs are pressing and promise to become more so.**

If **you are working on purely civilian goods, your problem is an even more difficult one. You will find it almost impossible to obtain certain steel items that are essential for defense. To fill the gap you will have to employ substitute steels. You'll need help not only in selecting the proper substitute steels, but in using them properly.**

We are prepared to assist you in either situation.

The steel engineers and metallurgists we have assigned to this important job of helping you use steel more *effectively* are the same men who were largely responsible for the development of National Emergency steels — one of the outstanding metallurgical accomplishments of World War II. These men can call upon the facilities of the most completely equipped steel research laboratories and the largest steel making plants in America. They can bring to the solution of your problems the very latest ideas and time-saving techniques in the working and treatment of steel. We urge you to draw freely upon this rich reservoir of experience.

UNITED STATES STEEL COMPANY, PITTSBURGH
COLUMBIA STEEL COMPANY, SAN FRANCISCO
TENNESSEE COAL, IRON & RAILROAD COMPANY, BIRMINGHAM
UNITED STATES STEEL SUPPLY COMPANY, WAREHOUSE DISTRIBUTORS, COAST-TO-COAST
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

USS

Carilloy Steels

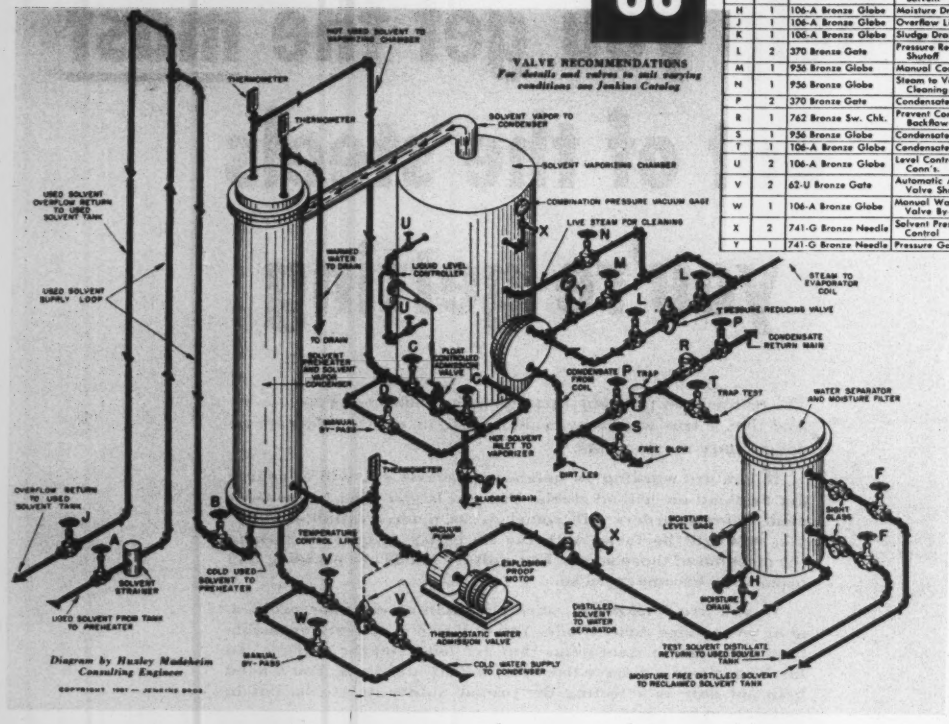
ELECTRIC FURNACE OR OPEN HEARTH — COMPLETE PRODUCTION FACILITIES IN CHICAGO OR PITTSBURGH

1-919

UNITED STATES STEEL

JENKINS PRACTICAL PIPING LAYOUTS

55



Code	Quan.	Jenkins Valves	Service
A	1	62-U Bronze Gate	Used Solvent Supply Shutoff
B	1	106-A Bronze Globe	Used Solvent to Preheater
C	2	62-U Bronze Gate	Float Controlled Valve Shutoff
D	1	106-A Bronze Globe	Manual By-Pass of Float Valve
E	1	92 Br. Sw. Check	Prevent Solvent Backflow
F	2	106-A Bronze Globe	Tank Connections for Distilled Solvent
H	1	106-A Bronze Globe	Moisture Drain
J	1	106-A Bronze Globe	Overflow Line Control
K	1	106-A Bronze Globe	Sludge Drain from Vaporizer
L	2	370 Bronze Gate	Pressure Reducing Valve Shutoff
M	1	936 Bronze Globe	Manual Control By-Pass
N	1	936 Bronze Globe	Steam to Vaporizer for Cleaning
P	2	370 Bronze Gate	Condensate Return
R	1	762 Bronze Sw. Chk.	Prevent Condensate Backflow
S	1	936 Bronze Globe	Condensate Free Blow
T	1	106-A Bronze Globe	Condensate Trap Test
U	2	106-A Bronze Globe	Level Controller Tank Conn's.
V	2	62-U Bronze Gate	Automatic Admission Water Valve Shutoff
W	1	106-A Bronze Globe	Manual Water Admission Valve By-Pass
X	2	741-G Bronze Needle	Solvent Pressure Gage Control
Y	1	741-G Bronze Needle	Pressure Gage Control

How to plan DRY CLEANING SOLVENT DISTILLATION PIPING CONNECTIONS

In the distillation system shown, used solvent is pumped from a storage tank through a strainer to a preheater. Here, cold solvent on the inside of the tubes is heated by the solvent vapors on the out-side.

The heated solvent then passes through a liquid level controller to the solvent vaporizing chamber. A steam coil in the vaporizer further heats the solvent and causes it to boil off, since it has a lower boiling point than the impurities. A sludge drain valve is used to remove these impurities periodically from the bottom of vaporizer where they collect (hence a high vacuum is maintained).

The reclaimed solvent generally is returned to the used solvent storage tank for reprocessing. It is then passed through filter pads where any last traces of moisture are removed and stored in a tank for reuse.

The valve recommended for control of both hot and cold solvent is Jenkins Fig. 106-A Globe Valve. When ordered for use in dry cleaning solvent lines, valves are fitted with Jenkins No. 936-A synthetic composition discs. These are specifically designed to withstand the corrosive action of solvents, and provide vapor-tight closure for a long period before disc renewal is required.

Consultation with accredited piping engineers and contractors is recommended when planning any major piping installations.

A CHOICE OF OVER 500 VALVES

To save time, to simplify planning, to get all the advantages of Jenkins specialized valve engineering, select all the valves you need from the Jenkins Catalog. It's your best assurance of *lowest cost in the long run*. Jenkins Bros., 100 Park Ave., New York 17; Jenkins Bros., Ltd., Montreal.

COMPLETE DESCRIPTION AND ENLARGED DIAGRAM OF THIS LAYOUT FREE ON REQUEST. Includes additional detailed information. Mail coupon for your copy.

JENKINS BROS., 100 Park Ave., New York 17

Please send enlarged reprint of Piping Layout No. 55

Name .....

Company .....

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JENKINS
LOOK FOR THE DIAMOND MARK
VALVES
SINCE 1864
TRADE JENKINS MARK

Jenkins Bros

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These announcements are obtained mostly from advertisers in MECHANICAL ENGINEERING and ASME MECHANICAL CATALOG

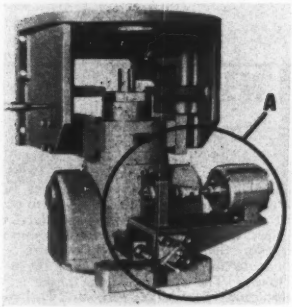
• NEW EQUIPMENT
• BUSINESS CHANGES
• LATEST CATALOGS

Available literature or information may be secured by writing direct to the manufacturer and mentioning MECHANICAL ENGINEERING as a source.

• NEW EQUIPMENT

Hydraulic Metal-Working Press

Development of an entirely new and revolutionary principle in hydraulic press construction is announced by Elmes Engineering Division of American Steel Foundries, Cincinnati, Ohio. In the new Elmes "pipeless" metal-working presses built on this principle, the main hydraulic circuit has no piping (A). The only pipes in the entire press are the pilot, suction, and drain lines, and of these, only the pilot line carries high pressure. All high-pressure fluid is conducted through short, direct passages drilled in the structural parts. As a result, there are no high-pressure screwed joints to loosen, no oil dripping from loosened fittings, and no possibility of welded joints breaking loose. Exceptionally smooth and shockless operation virtually eliminates vibration.



These distinct advantages over the conventional hydraulic system make for remarkably low-cost maintenance, with downtime practically eliminated. Maintenance is as easy as it is economical. The pumping unit can be removed as a unit assembly without disconnecting any piping. The valve unit, located in the oil reservoir, is also removable as a unit assembly. All pumping units and valve groups fit standard bolting and drilling layouts, making for greater flexibility in the variety of possible pumping arrangements.

Reversing-type hydraulic pumps, known to give the smoothest possible press performance, are used in the new circuit. Even the shifting and centering system is a miniature pipeless circuit in itself. Since this unit is mounted directly to the hydraulic pump, only electrical or mechanical connections need be made, depending upon the style of control.

The pipeless valve unit is really the heart of the new circuit, containing all necessary provisions for prefilling during rapid advance, changing to pressing speed by either pressure or position, and decompression prior to reversal. These valves are designed in a wide range of sizes for application to many different speeds and tonnages. In extreme cases, multiple units are used.

Any Elmes hydraulic metal-working press, standard or special design, can be supplied with pipeless construction for the main hydraulic circuit.

For further information write American Steel Foundries, Elmes Engineering Division, 1171 Tennessee Avenue, Cincinnati 29, Ohio.

Spreader Stoker

Spreader Stoker—Bulletin No. 890 describes a spreader stoker having overthrow rotors that provides exceptionally uniform fuel distribution. Available with stationary, hand dumping and power dumping grates. Many sizes assure efficient application to all types of boilers and steam generators. Successfully burns all grades of bituminous coal, lignite, and various kinds of wood and other refuse. Detroit Stoker Co., Detroit, Mich.

All-Purpose Lathe Attachment

"Du-Ona-Lathe," a revolutionary vertical rotary attachment which actually permits a lathe to do precision jig boring ordinarily possible with a $12,000 machine, is currently being manufactured by the Allan Mfg. Co., Long Island City, N. Y.

A precision tool, Du-Ona-Lathe guarantees an absolute $^1/_{10}$ of 1 deg accuracy, and performs many diversified jobs, including drilling, reaming, flycutter facing, and jig and fixture work.

With an over-all compact and efficient design, Du-Ona-Lathe has a massive meehanite cast-iron body for rigidity and permanent accuracy.

A saver of time, money, and equipment, Du-Ona-Lathe is suitable for use as a surface grinder in forming triangles, hexagons, or unusually shaped punches and tools. This Allan product will fit all 9-in. South Bend lathes, with other models available for 9 and 10-in. lathes.

Illustrated brochure, available from manufacturer.

Synchro-Glide Elevators

Soon there will be high-speed elevators in New York City that glide to a stop as gently as a leaf floats to the ground.

In the 30-story Sinclair Oil Building, now nearing completion at 600 Fifth Ave., there are four 800 and four 500 fpm Westinghouse elevators equipped with a new control development — called Synchro-Glide — that cushions an elevator's landing so much that most passengers hardly know the exact moment the car has stopped. This new control development slows the speed of the elevator so gradually after it enters the landing pattern—a point 20 in. from the floor—that during the last half inch of travel, the speed is only 7 fpm.

In addition to making the elevators' landings so smooth, the new Synchro-Glide landing system also makes them faster and almost infallibly accurate. Each car's passenger-handling capacity is increased by up to 10 per cent as the cars are not slowed down for a stop until they are much nearer the floor than with other automatic landing systems. This saves a second-and-a-half on each floor-to-floor trip.

Elevators in the Sinclair Oil Building may arrive at the heart of the landing pattern—while traveling at an approach speed faster than ever before possible, 250 fpm. As a car approaches a floor where it is to stop, the landing system is automatically set into operation. Because Synchro-Glide so closely regulates the speed of the elevator, even during the final 20-in. landing pattern, the cars make perfect pin-point landings every time, the first time. Doors' operation is completely synchronized with the cars' slowdown.

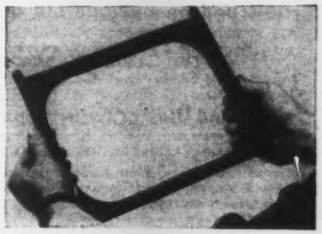
The four elevators that serve the building's upper floors, have room for 16 passengers and travel at a top speed of 800 fpm. The four low-rise cars, with room for 23 passengers, travel 500 fpm.

Descriptive Bulletin 500–210 on the Synchro-Glide Landing System is available from Westinghouse Elevator Division, Jersey City, N. J.

New T-V Mask

The Cathode-ray Tube Division of Allen B. Du Mont Laboratories Inc., Clifton, N. J., has announced a specially designed T-V mask for simplifying the replacement of the Types 12JP4 and 12RP4 with the Type 12QP4A.

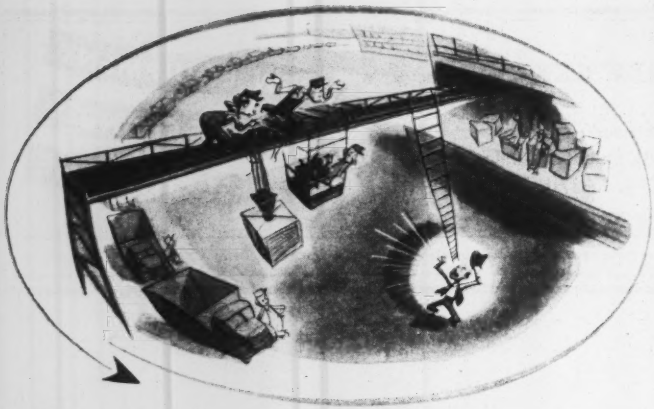
The new mask is available through the authorized Du Mont Teletron distributors at low cost, and will adapt the Type 12QP4A to early Du Mont Telesets and most receivers of other manufacture which employ either the 12JP4 or 12RP4.



Popularity of the Type 12QP4A as a replacement for the 12JP4 and 12RP4 is based on its close similarity to these older types, plus the features of a flatter face, and a gray filter face plate.

The greater radius of face curvature of the Type 12QP4A, which is the largest con-

Continued on Page 42



Burned-out Motors Waste Manpower!

Men without motors are just about as helpless in a modern factory as a wagon without wheels on a superhighway.

In many plants the failure of a single motor used to drive an overhead crane or a conveyor system can cost thousands of dollars an hour in lost production and wasted man-hours of labor.

The answer is Class H insulation made with Dow Corning Silicones. In a steel mill, for example, a cupola crane hoist motor insulated with the best Class B materials had an average life of only 50 days. Rewind costs alone amounted to $3,634 in three years. That motor, rewound with Class H Insulation at an extra cost of only $79 was still in good condition after 613 days on the hoist and 908 days on the trolley bridge.

And Class H is readily available. Most of the best rewind shops now feature this longer lasting, more reliable class of insulation. Leading motor manufacturers are quoting price and delivery on new Class H machines.

Dow Corning Silicones Mean Business!

MAIL THIS COUPON TODAY!

DOW CORNING CORPORATION, MIDLAND, MICHIGAN
Please send me ☐ More Evidence ☐ List of Class H Rewind Shops ☐ List of Motor Manufacturers Offering New Class H machines. Q-6

Name_____
Company_____
Street_____
City_____ Zone____ State_____

DOW CORNING SILICONES
DOW CORNING CORPORATION

BRANCH OFFICES: ATLANTA • CHICAGO • CLEVELAND • DALLAS • LOS ANGELES NEW YORK • WASHINGTON, D. C. • In CANADA: Fiberglas Canada Ltd., Toronto In GREAT BRITAIN: Midland Silicones Ltd., London.

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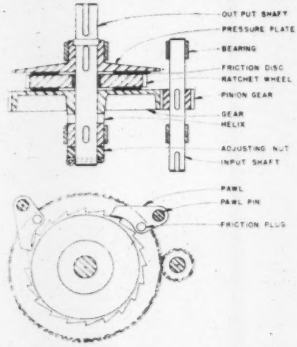
sideration in replacing the older types, is compensated for by the mask, making the replacement simple and direct. When replacing the Type 12QP4 for the Type 12JP4 an ion-trap magnet must be added.

Mechanical Load Brake

A new automatic mechanical load brake designed for use with cranes and other hoisting equipment has been announced by the Downs Crane and Hoist Co., Los Angeles, Calif. The brake automatically provides a positive control on the lowering speed of the load. Thus a suspended load will not overhaul the hoist motor and drop at a dangerous rate of speed. Downs automatic mechanical load brakes will also hold in any position independent of any other brake in the hoisting system. The hoist motor may be disconnected and removed with a full load hanging from the hoist without danger.

The brake is of the Weston type (two-disk construction), helix-operated, and is built into the second or low-speed shaft of the assembly. The load is kept from lowering or running down by two pawls in contact with a



ratchet wheel. The weight of the load acting through a helix produces an axial thrust which clamps the ratchet wheel between two friction disks with sufficient pressure to prevent all rotation in the lowering direction. By operating the hoist motor in the lowering direction, the pressure on the helix is relieved and the brake opens, allowing the load to lower. The opening of the brake is in direct proportion to the load, and just sufficient to permit the load to lower under direct control of the motor, and at motor speed. Since the motor exerts power to hold the brake open and drive the load downward, the load cannot overhaul the hoisting mechanism. When the hoist is operated in the upward or lifting direction, the pawls lift clear of the ratchet wheel by means of friction plugs, and the entire mechanism runs free. The brake housings are oil-tight, and the entire mechanism operated in oil. This insures proper lubrication and an abundance of oil for dissipation of frictional heat generated during the lowering cycle.

Electronic Combustion Safeguard

A new electronic combustion safeguard system for commercial oil burners, which provides immediate cut-off of fuel in case of failure, has been announced by General Electric's Control Divisions.

Listed by Underwriters Laboratories, Inc., and approved by Factory Mutual Laboratories, the co-ordinated equipment includes a switch-amplifier-contactor unit, phototube holder, and electrode holder.

QUICK ANALYZING WITH AP-1

Panoramic Sonic Analyzer, Model AP-1 — Specially recommended for high speed analysis of harmonics, vibrations, noises, acoustics.

SPEEDS PRODUCTION FOR GENERAL ELECTRIC

Panoramic Sonic Analyzer, Model AP-1, is used for isolation of critical frequencies. "Very helpful," says GE Superintendent.

QUICK ANALYSIS OF CRITICAL FREQUENCIES

in high speed rotors speeds the process of dynamically balancing air-borne gyroscopic instrument parts.

PANORAMIC CAN HELP YOU

Wave analysis through the automatic analysis and spectrographic presentation of the audio spectrum is an invaluable asset in a variety of applications. Let a Panoramic specialist advise you on your individual production problems.

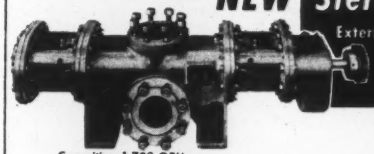
WRITE FOR FULLY DETAILED BULLETIN

PANORAMIC
RADIO PRODUCTS, INC.
10-12 SOUTH SECOND AVENUE, MOUNT VERNON, N.Y.

★ NEW Sier-Bath SCREW PUMP

External Gear and Bearing Bracket Type

FOR NON-LUBRICATING LIQUIDS, SEMI-LIQUIDS



Capacities: 1-700 GPM
Discharge: 1000 PSI for viscous liquids
300 PSI for water

★ Greater Dependability
★ Lower Maintenance Costs
★ Longer Life

★ **New Single-Point Alignment** — eliminates bearing strain and rotor misalignment due to change of position of pump elements. Housings for external timing gears and bearings bolted directly to pump body — thus move with pump body if it is displaced during installation, or if it expands when handling hot liquids.

★ **New "Dual-controlled" Rotors** — for less wear on bearings and timing gears. Axial control by heavy-duty thrust bearings — radial control by precision cut timing gears and heavy-duty roller bearings.

★ **New Speed in Servicing** — gear housing center line supported, doweled for accurate alignment. All parts automatically positioned by shoulders and locknuts.

PLUS These Regular Sier-Bath Advantages:

No metallic contact between rotors — sustains high volumetric efficiency.

Only suction pressure on stuffing boxes — reduces packing maintenance.

Less strain on valves and piping — minimum cavitation because pump reduces velocity change. Eliminates hammer, vibration.

Direct-connected up to 1800 RPM, Self-priming, Pulseless Discharge.

Available in horizontal or vertical construction, corrosion resistant alloys. Special bodies, stuffing boxes and bearings for high temperature applications. Sier-Bath "Gearex" Pumps for lower pressures and capacities.

WRITE FOR FURTHER INFORMATION
9278 HUDSON BLVD.
NORTH BERGEN, N. J.

Sier-Bath GEAR and PUMP CO., Inc.

Also Makers of Sier-Bath Precision Gears and Gear Couplings

Founded 1905 Member A.G.M.A.

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According to G-E engineers, the system assures positive protection against combustion failure because (1) if the gas pilot does not ignite, the oil valve cannot open, and (2) if the oil flame does not ignite, the supply of fuel is cut off. After the cut-off, the motor continues to operate for 30 sec to purge the nozzle or cup of unburned fuel to prevent carbonizing and reduce field servicing. The system is then locked against further operation until manually reset.

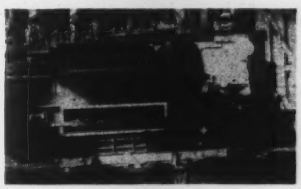
An oil temperature thermostat can be used with the circuit in this control to assure satisfactory fuel oil temperature before the starting cycle begins. Upon resumption of service following a power failure, low water cut-off, or limit control operation during the starting cycle, the oil valve cannot open until the program switch recycles.

When continued operation of the burner is prevented by ignition failure, a positive lock-out mechanism is actuated and a light on the cabinet cover indicates that the equipment has gone to lock-out. Operation cannot then be resumed until the reset button is pushed.

Packaged Power Plant

A 157,000-lb "packaged" power plant, mounted as a single unit on a special low-bed railroad car, recently rolled out of the Westinghouse Electric Corp. plant at Sunnyvale, Calif., bound for Georgia.

Comprising steam condenser, steam turbine, and electric generator, the unit will go into service soon to add 5000 kw to the power supply of the City of Thomasville, Ga.



On arrival at its destination, the plant will require only placement in a building prepared for the purpose, and connection to fuel and water lines and a boiler.

It is the 25th such unit to be made and shipped by the Westinghouse plant at Sunnyvale in the past two years. Others have gone into service in Mexico, Colombia, San Salvador, the Argentine, India, and elsewhere.

The steam turbine and 5000-kw electric generator are mounted in pickaback fashion atop the steam condenser in the compact unit. The turbine is designed to operate at a pressure of 400 psi, with steam at a temperature of 750 F, and rotate at 3600 rpm.

More than 3300 carefully machined stainless-steel blades are mounted in rows on parallel disks of varying diameter on the turbine spindle. Tips of the blades on the largest disk attain a velocity of more than 550 mph when the turbine is operating at its rated speed and the generator is producing its rated 5000 kw.

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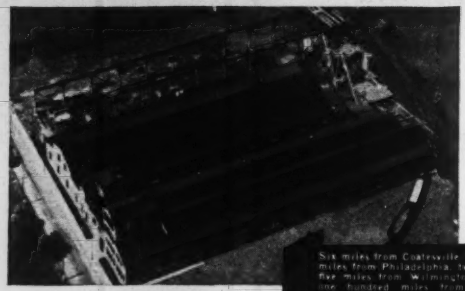
The Home of CUSTOM-MADE PRODUCTS



Six miles from Coatesville thirty miles from Philadelphia twenty-five miles from Wilmington and one hundred miles from New York City lies the strategically located home of Downingtown Iron Works. Nearby Steel Producing Centers provide necessary raw materials an industrial and home community supplies skilled labor and the main line of the Pennsylvania Railroad assures excellent transportation facilities.

PLATE FABRICATION and HEAT EXCHANGERS

Nearly 40 years ago the present management of DOWNINGTOWN IRON WORKS, INC. began to attain, and then maintain, the reputation of being "*among the finest in their field*"; i.e., Steel Plate Fabrication. We, of DOWNINGTOWN, take justifiable pride in knowing that through these years we have never once sacrificed *quality* for price. The many developments in the variety of metals and methods of fabricating these metals have made our work most interesting, and we also like to feel that we have contributed, in a small way, to advancing the economy of our Country. Our Heat Transfer Division, started in 1941, is maintained under the direction and supervision of men thoroughly trained and experienced in this line. Heat Transfer Equipment of DOWNINGTOWN design is sold on a guaranteed performance basis or we will fabricate to customer's drawings. Useful literature gladly sent upon request on your Business Letterhead. May we be of help to you? Remember, "Your needs are our Specialty"!

DOWNINGTOWN IRON WORKS, INC.

DOWNINGTOWN, PA.

NEW YORK OFFICE, 30 CHURCH STREET

More than 5½ miles of bronze tubing—1529 separate tubes, each 20 ft long—carry cooling water through the condenser.

Wide acceptance of the unit power plants throughout the world stems from the simplicity of design, compactness, and the open arrangement of all components and interconnecting piping, making erection, operation, and maintenance easy and economical. Designs have been developed to enable use of the most readily available and economical fuel—oil, gas, coal, lignite, or wood.

Glass Insulation

A new glass insulation is now being used by the General Electric Co. to increase the life of its cast-in-concrete reactors. The new insulation is capable of withstanding extremely high operating temperatures without deterioration.

According to G-E engineers, the new insulation is free of metallic impurities found in most asbestos tapes and provides more dielectric protection against turn-to-turn short circuits than other types of wound insulation used in reactor manufacture. Moreover, they pointed out, glass insulation is completely unaffected by moisture.

The improved air-core current-limiting reactors are also wound with cable consisting of continuously transposed conductors which, G-E engineers said, will produce lower power losses and greater short-circuit strength.

Metal housing for the reactors minimizes stray current and electrical losses.

•Keep Informed

Air-Conditioning Units

Incorporating many important new design changes, inside and out, the new line of 1951 Bakeraire units was introduced at a 3-day meeting of the Baker Refrigeration Corp. national sales organization recently, in South Windham, Maine.

Featuring greater cooling efficiency in a more compact design, the new Bakeraire line is built in capacities of 3, 5, 7½, and 10 tons. Over-all height has been substantially reduced in every model. Each unit is constructed with a one-piece rigid steel frame and a removable plenum designed for front or rear discharge. Extreme operating quiet is assured by means of vibration eliminating spring compressor mountings.

Cooling efficiency has been increased through a new cooling coil in the compressor compartment to dissipate heat. New water and drain connections make this the easiest and fastest of all unit air conditioners to install.

Exterior cabinet design is modeled in smooth, modern, unbroken lines with a new, highly durable "Baker gray" finish that is easily cleaned. Either open-type or hermetic compressors are supplied with the new units.

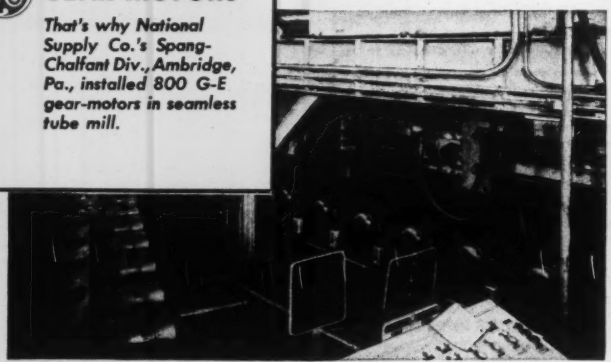
Also introduced at the meeting were several equally important design improvements: Full capacity reduction for larger Baker Freon compressors which makes possible a wide range of operating capacities from 100 to 17 per cent. A new condenser for Bakeraire. A new, low-cost, cleanable air filter.

Recently revamped and modernized production-line facilities, including many new machine tools, were shown to the sales organization to demonstrate Baker's greatly expanded plant capacity for both refrigeration

GEAR-MOTORS

That's why National Supply Co.'s Spang-Chalfant Div., Ambridge, Pa., installed 800 G-E gear-motors in seamless tube mill.

HIGH-SPEED SOLUTIONS TO.....



On billet-heating operation, 60 compact G-E gear-motors save much-needed space formerly taken up by line shafts and gears. Automatic control of the 1-hp gear-motors boosted production and turned out better products.

One gear-motor for each driving roller eliminates excess maintenance costs and hazards of former line shafts and separate, unprotected gears.

• Keep Informed

and defense work. New sales policies developed to assure equitable distribution of Baker equipment in today's market were presented along with the 1951 advertising and promotion program. . . largest in Baker's history.

New Pumps

Three large pumps with a total capacity for handling 63,000 gpm of water will be installed by the Machinery Div. of Dravo Corp. for the new open-hearth furnace plant at the Jones & Laughlin Steel Corp. Pittsburgh Works.

The pumps will be housed in a reinforced-concrete structure along the shore of the Monongahela River. Construction of this river intake within a sheet-steel cofferdam has been started by the Contracting Division of Dravo.

Each of the three DeLaval pumps will be driven by a 1250-hp electric motor. Water from the river will be screened, strained, and treated before being pumped into the mill's piping system.

At J. & L's Aliquippa Works, Dravo's Contracting Division will construct a new coal-unloading dock extending some 1650 ft along the Ohio River bank.

Included in this project is a 466-ft steel pile wharf with a central reinforced-concrete pier for support of coal-unloading machinery. Also to be installed are seven sheet-steel mooring cylinders 16 ft in diam and three ice breaker cylinders 25 ft in diam.

Portable Conveyer

The Hytrol portable folding conveyer has proved a "one-man gang" for fast handling of many kinds of products packaged in bags, boxes, bundles, bales, and cartons according to the Seedburo Equipment Co., Chicago, Ill. Much of its popularity is due to its compact size, light weight, and mobility. One man can move it about and operate it. The Hytrol conveyer is especially adapted to materials-handling chores in warehouse aisles, and other small areas, and for between-floors operations. It can be moved, or have the angle of delivery changed, while the conveyer mechanism is in motion. The conveyer is made in 5 sizes, each of which folds to one-half its own length. Thus, the largest Hytrol conveyer can be stored in an area less than a half-yard square.

The Hytrol conveyer is built low to the floor. The low lift saves the worker's time and energy. The flow of materials may be reversed at any time while the machine is in operation simply by turning a switch. It can handle fifteen 100-lb bags per min. Moving parts are concealed to protect both the worker and the products being handled. Made without unnecessary sides, the Hytrol conveyer can handle boxes, cartons, and other packages which are extra wide. Because it is portable, it can be moved easily in and out of freight cars, or used on loading docks for stacking and unstacking.

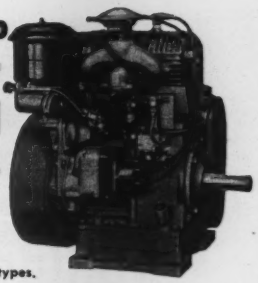
Hermetically Sealed Thermostat

Spencer Thermostat, Division of Metals & Controls Corp., Attleboro, Mass., announces a new thermostat C4391. These new, small snap-action disk-type thermostats are hermetically sealed with terminals brought out through glass seals and with rubber bonded over the terminals and to the

Continued on Page 48

POWER ADVANTAGE in the 7 to 13 hp. Range...The 2-Cylinder

WISCONSIN *Air-Cooled* **ENGINES**



Here is the POWER ADVANTAGE story of the 2-cylinder Wisconsin Heavy-Duty Air-Cooled Engines, the development of which fills the need for a power linkage between the single-cylinder and four-cylinder types.

1. Dependable air-cooling under all climatic and weather conditions.
2. Self-cleaning tapered roller bearings at both ends of the crankshaft to withstand either side-pull or end-thrust without danger to bearings.
3. Rotary type high tension OUTSIDE Magneto with Impulse Coupling operates as an entirely independent unit that can be serviced or replaced in a few minutes.
4. Maximum torque at usable speeds for equipment that really has to go to work.

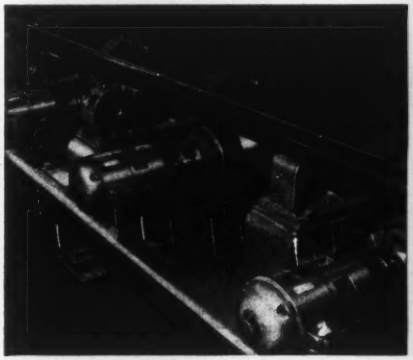
CONDENSED SPECIFICATIONS

MODELS		TE	TF
Bore	inches	3	3¼
Stroke	inches	3¼	3¼
Piston Disp. cubic inches		45.9	53.9
Horsepower			
1400 rpm		7.2	8.6
2000 rpm		10	12
2600 rpm		11.2	13.3
Net weight in lbs., Standard engine, side-mount tank		220	220

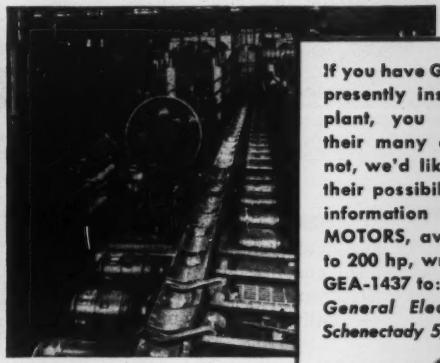
Our engineering department will gladly cooperate with you in adapting Wisconsin Engines to your requirements. Write for detailed data and name of the nearest Wisconsin distributor.

WISCONSIN MOTOR CORPORATION
World's Largest Builders of Heavy-Duty Air-Cooled Engines
MILWAUKEE 46 WISCONSIN

LOW-SPEED PROBLEMS — G-E GEAR-MOTORS



Automatic operation reduced labor costs. Dependability of G-E gear-motors lessened breakdowns. Standardization of motors minimized stocking of spare parts.



As a result, National Supply has installed more than 800 G-E gear-motors for their low-speed drives.

If you have G-E gear-motors presently installed in your plant, you already know their many advantages. If not, we'd like to show you their possibilities. For more information on G-E GEAR-MOTORS, available from 1 to 200 hp, write for bulletin GEA-1437 to: *Section F755-6, General Electric Company, Schenectady 5, New York.*

GENERAL ELECTRIC

Preferred power on orchard sprayers and other orchard equipment — the world's most widely used single-cylinder gasoline engines on machines and tools for industry, construction, railroads, oil fields, etc., and on appliances and equipment for farm and home.

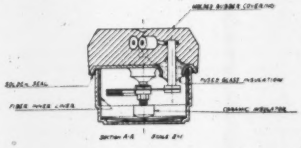
THIS TRADE-MARK is your guide to all that is best in 4-cycle, single-cylinder, air-cooled gasoline engine performance.
Briggs & Stratton Corporation,
Milwaukee 1, Wis., U.S.A.

In the automotive field Briggs & Stratton is the recognized leader and world's largest producer of locks, keys and related equipment.

• Keep Informed

rubber covered leads so as to be completely weatherproof and waterproof. For extremes of temperature, both high and low, silicone rubber can be used in the molding and on the leads.

The problem of transmitting the temperature to be controlled to the disk thermal element within the hermetic enclosure has been solved by mounting the disk in the bottom of the metal enclosure where it closely follows the temperature of any surface on which the thermostat is mounted or of air or liquids to which the bottom of the thermostat is exposed.



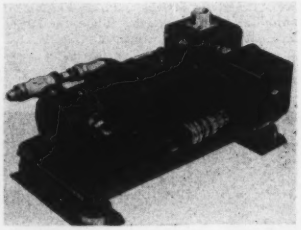
The disk-type snap-action gives a positive switch action which withstands vibration, shock, and motion for military applications on aircraft, tanks, and vehicles as well as civilian uses. Designed originally for electric refrigerator automatic defrost control where it mounts directly on the refrigerator evaporator, the maker expects these thermostats to have many uses in both military and civilian equipment.

The switch action may be either single throw or double throw, single pole.

Electrical rating is 10 amp, 30 volts d c and 125 volts a c, 8 amp 250 volts a c.

High-Speed Air Compressor

A high-speed $^{3}/_{5}$-hp air compressor Model RR-9060 with a capacity in excess of 1 cfm at 15,000 ft altitude has been announced by Lear, Inc., Elyria, Ohio. Designed for operation at 50,000 ft to hold constant pressure in radar and other electronic plenums of aircraft, the compressor has a minimum pumping capacity of 110 cu in. per min, and 35 in. Hg absolute pressure. It has a suction of 2 in. Hg abs.



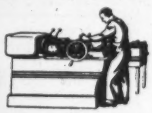
Model RR-9060 consists of a shock-mounted pressurizing kit of electric-driven pump, absolute pressure switch, starting relay, and check valve. Valve permits pump to cycle on-and-off without loss of system pressure, controlled by the switch. Weight is 14 lb.

Motor is 0.4 hp, 27 volts d c, 16 amp, 6200 rpm. Pump-and-motor rotor shaft runs on three ball bearings, prelubricated for 1000 hr.

Positive displacement, rotary pump has self-lubricating Graphitar blades. Blades do not stick at −85 F, and no oil is present to contaminate pump or the compressed air; $^{9}/_{16}$−18 male fittings for $^{3}/_{8}$-in.-OD tubing are supplied in pump ports.

An inlet-type filter-dehydrator is available as extra equipment.

TIPS ON TAPPING AND THREADING TROUBLES



DATA

Page A-6

- OILS FOR TAPPING AND THREADING

Oils With Active Sulphur Required

Tapping and threading are difficult machining operations due primarily to limited chip room and the difficulty of maintaining sufficient lubrication at points of contact between threading tool and workpiece. Cutting oils having high sulphur activity are usually required and recommended for difficult threading and tapping work. Stuart's THREDKUT and related products, due to their high effective sulphur content, have been outstanding for this class of work. Active or effective sulphur in an oil functions as an anti-weld agent preventing pick-up of metal particles on the tool which results in scuffing and poor finishes.

Rule of Thumb

Here is a good rule of thumb to remember when sulphurized cutting oils are being used:

When you observe excessive wear on the front clearance of cutting tools, DECREASE the amount of active sulphur in the oil by diluting with paraffin oil or other low cost blending oil. If poor finish is encountered due to welding or metal pick-up on the tool edge, INCREASE the active sulphur, or if Stuart's THREDKUT is being used, apply it straight.

RESULTS

Operation: Threading male pipe union sections on large automatics using single point tools.

Material: Type 310 stainless steel.

Oil:	Previous Oil	Stuart's THREDKUT 9961
Tool Life:	135 pcs. per tool grind	310 pcs. per tool grind
Part Finish:	Fair	Excellent
Cutting Fluid Costs on Machine:	$0.47 per gal.	$0.44 per gal.

Write for Literature and ask to have a Stuart Representative call

D.A. Stuart Oil CO.

2741 S. Troy St., Chicago 23, Ill.

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Plastic Handle

A tough plastic handle for a 100,000 cp portable searchlight is being molded of brown G-E rubber-phenolic compound, produced by the General Electric Co. Chemical Department, to reduce breakage in assembly operations and to withstand abuse in service. Werner Manufacturing Co., Brookfield, Ill., is the molder.

G-E 12489 woodflour-filled rubber-phenolic compound was specified for the pistol-grip handle of the Unity 110-volt plug-in searchlight manufactured by the Unity Manufacturing Co., Chicago, Ill. The handle is molded in two sections and is held together with screws. A $\frac{1}{2}$-in. hole is tapped at the top of the handle for insertion of a toggle switch.

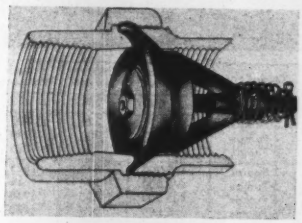
After experimenting with a variety of general purpose phenolics, G-E 12489 rubber-phenolic compound was approved and adopted. Because of its high internal resiliency, better machining and tapping has been obtained with less breakage during assembly operations, and because of the high shock resistance of General Electric rubber-phenolics, 5 to 10 times that of conventional phenolic materials, less damage in service is also obtained.

Though molded of an impact material, the handle is attractive in appearance. The resiliency of G-E woodflour-filled rubber-phenolic compounds, attributed to nitrile rubber, permits the design of shock-resistant parts without sacrifice in appearance, and can be molded without the inconvenience generally associated with bulky conventional impact materials in preforming, molding, and finishing operations.

Check Valve

Universal Valve Co., Elizabeth, N. J., will experiment with industrial applications of their Union check valve to solve individual suction and discharge line problems.

Use of the valve has been limited, at present, to the petroleum industry, to emergencies caused by a faulty angle or foot check valve. Installed within a standard union at the base of a gasoline pump above ground, the Universal Union check valve eliminates suction line leak, and maintains a prime until repairs to the permanent installation can be made. The valve can be installed in any position in any existing union.



It is claimed that these features make the valve economically ideal as a permanent installation in suction or discharge lines, or as an emergency measure where repairs would cause a loss of production and money.

Both the valve body and spring-action poppet are made of bronze, but may be made from other metals. The poppet seat can be made of ferrous or nonferrous metals, synthetic or natural rubber, impregnated cork or plastic. Present valve bodies are $1\frac{1}{4}$, $1\frac{1}{2}$, and 2 in. No gaskets are required. Valve can be easily removed from union for quick cleaning.

Continued on Page 48

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ORGANIZED presentation of the problems of model design and interpretation of tests with them. The concepts and techniques of dimensional analysis are used to develop the principles of model design, with applications to structural fluid flow, thermal, electrical, acoustical, and chemical problems. Model-prototype relationships and analogies are thoroughly covered. Stressing the experimental approach, this book is invaluable to design engineers in any field. *302 pages.* $7.00

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COMPREHENSIVE volume presenting principles and methods of control in industry, by restating and interpreting philosophies and fundamentals developed by great leaders in terms of present business conditions. Special attention is given to the development of sound human relations. Recognizing the necessity of engineering economy, it offers a quantitative and factual treatment of methods, techniques and practices, as contrasted with a descriptive approach. *780 pages.* $6.00

GAS TURBINES

By H. A. SORENSEN

THREE objectives of this book are to present the thermodynamic principles, elements of design, and the construction features of the gas turbine. It includes chapters describing open-cycle and closed-cycle gas turbines, axial-flow compressors, centrifugal and positive displacement compressors, axial-flow turbines, combustion systems, structural design, plant performance, and an appendix of the properties of air and combustion gases. Aircraft gas turbines and jet propulsion are covered in several sections of the book. *550 pages.* $6.50

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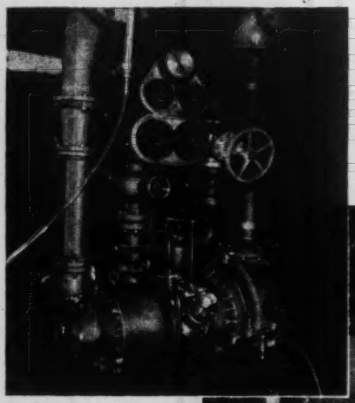

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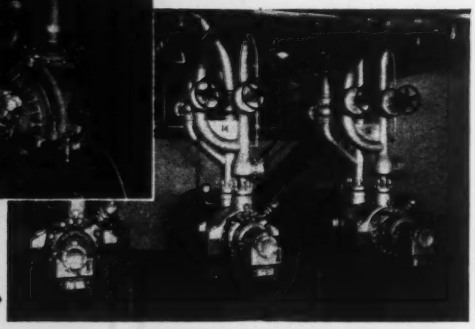

Pacific Steam Turbopump

Typical Utility Boiler Feed Pump Installation

Type	Quantity	Pounds Per Hour	Degrees Temp. F.	Pounds Pressure
STEAM TURBOPUMPS	12 Pumps	31,600	250	810
ABF CENTRIFUGAL PUMPS	3 Pumps	358,120	220	1300
	4 Pumps	350,000	300	1060
	4 Pumps	455,000	336	1225
IBF CENTRIFUGAL PUMPS	3 Pumps	425,000	310	1825
	3 Pumps	495,000	306	1619
	6 Pumps	405,000	305	1750
	6 Pumps	405,000	305	1750
	3 Pumps	450,000	310	1825
	6 Pumps	550,000	334	2200
JBF CENTRIFUGAL PUMPS	2 Pumps	163,600	260	490
	1 Pump	117,500	250	775
	30 Pumps	95,000	250	810

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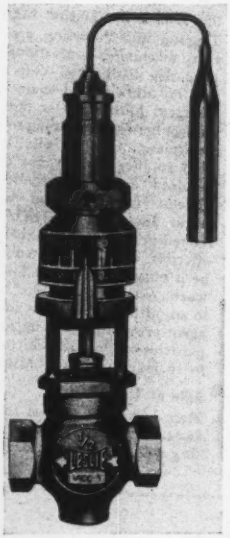
Temperature-Regulator Dial

A new calibrated dial for use with Leslie Class T and Class M type temperature regulators has been announced by the Leslie Co., Lyndhurst, N. J.

The dial embodies several new features which assure quick, easy, and dependable temperature settings. It is timesaving in that a quick turn of the dial to the desired setting is all the attention that is necessary. There is no need to wait for the equipment to heat up to find out if the setting is correct.



The new calibrated dial is also said to provide protection against costly overheating caused by guess setting. In addition, it is designed for long life under rugged operating conditions such as production-line use where frequent readjustments are necessary for process work.

The dial fits in place of standard adjusting sleeve. There are no complicated linkages or gages to go out of order or to add friction.

Calibrated dials are easily installed on Class T and Class M type regulators already in service.

Carbide Dies

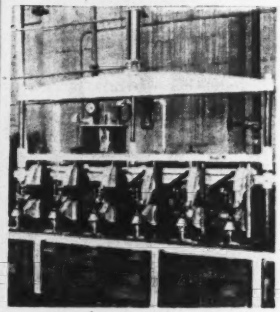
Use of carbide dies for both blanking and forming has solved a bad headache during its peak production season for the John E. Mitchell Co. of Dallas, Texas. The dies have virtually eliminated all costly former press downtime for die changes during peak production, aside from increasing over-all die life some 65 times.

The dies are used for producing channel-shaped "saw-bands" used in Mitchell cotton cleaning machines. Stock is 0.030-in-thick cold-rolled C-1040 strip steel, purchased in rolls. The stock feeds into one end of the automatic saw-band machine in a horizontal position from the reel.

An oval hole in the channel saw is punched first. The blanking die then punches the teeth and the forming die gives the section of steel band its final channel shape. The round hole is then punched and the saw-band is cut off to length.

According to Mitchell, steel blanking dies

Ledeen cylinders improve the job



CYLINDER OPERATES 6-SPOUT BOTTLED WATER FILLER HEAD

● Six 5-gallon bottles are filled every 30 seconds by filler head in bottled water plant. Ledeen Cylinder lifts and lowers entire head with centering bells and spouts. Head is automatically lifted by cylinder when bottles are filled.

Standard Ledeen cylinders and mounting attachments are available from distributors' stock in major cities. Special cylinders on order.

Write for New Bulletin 500.

There are Ledeen *Medium Duty, Heavy Duty* and *Super Duty* cylinders for air, oil or water operation ready to help you, wherever you have to push or pull • lift or lower • press or squeeze • tilt or turn • open or close

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Ledeen Mfg. Co.
1600 San Pedro
Los Angeles 15 Calif.

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had to be sharpened at least once a day during the busy season. The Carboloy blanking die performed 20,000,000 blanking operations—a normal full year's operation—before it had to be sharpened. Thus, more than 30 hr of maintenance time per machine are being eliminated each year—most of it in the "rush" season—since downtime was at least 15 min per die change.

Although the initial sets of Carboloy blanking and drawing dies have not as yet worn out, Mitchell estimates that the life of the blanking portion of the die will be at least 100,000,000 blanks as compared with the 1,500,000 blanks for comparable steel dies—an increase in service life of more than 65 times.

Luminescent Tape

A luminescent packaging tape has been developed by Century Coating Co., Whitestone, L. I., N. Y. Ideal for use in blackout areas, the luminescent tape can be seen easily from a distance of several feet. It is used to seal and mark boxes and containers of all sizes and shapes, and can be put on any object that must be readily identified in the dark.

Government specifications are now being written, and it is believed that the new "glowing" tape will be used by the Quartermaster Corps, Signal Corps, Corps of Engineers, and the Navy.

In order to instill toughness, abrasion and chemical resistance, flexibility in hot and cold weather, and to insure a moistureproof coating for the luminescent pigment, it was decided to use a plastisol made from Geon paste resin, a B. F. Goodrich Chemical Co. product, as a coating for the tape.

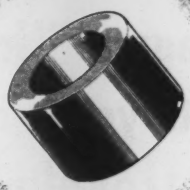
A succession of plastisol coatings or layers are put on fabric in six passes through a spread coating unit; the top layer is a clear 2-mil film under which is the pigmented luminescent layer, and then base coats. After the various coatings are applied, the 36-in-wide fabric is cut to usable roll 4 in. wide. The adhesive is protected while not in use by covering which is easily stripped off.

Concrete Testing Machine

Redesigned to separate the loading and weighing units, a new concrete testing machine of 100,000-lb capacity is announced by Baldwin-Lima-Hamilton Corp. The two-unit design prevents transmission of load shocks to the indicator and keeps the operator out of range of flying or falling particles from breaking specimens. Welded construction of the loading unit and simple structural lines of both units have greatly improved the appearance of the machine.

Continued on Page 50

WORKS WHERE OTHERS WON'T



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With This NEW Improvement Niagara "No-Frost Method" puts you a big step ahead in trouble-free, automatic refrigeration or freezing

Niagara "No-Frost Method" keeps frost and ice COMPLETELY OUT of your cooling, chilling, freezing or cold storage.

It uses Niagara No-Frost Liquid Spray to keep frost and ice from ever forming. It gives you, automatically, refrigeration with no defrosting, and full capacity NEVER cut down by ice building up progressively on refrigeration coils.

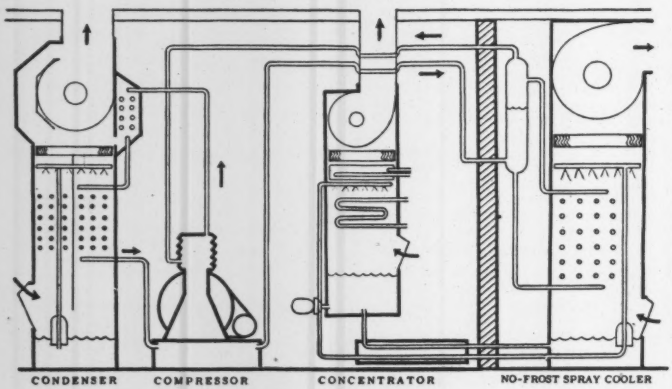
Now, a NEW design No-Frost Liquid concentrator, using a new principle, takes away moisture as fast as it is condensed by evaporating it at low temperature — not boiling it away at high temperature. It has 14 times the capacity of the old method per dollar of investment — one concentrator will handle a battery of high capacity spray coolers.

This gives you more refrigeration at lower cost; less machinery in less space. You operate at high suction pressure, saving power and wear and tear on compressors.

The extra capacity and lower cost both for equipment and operating makes this method advantageous for every type of refrigeration use — both for freezing and for moderate temperatures — for large "live" loads as in meat chilling or in fruit and vegetable pre-cooling — for rooms that are filled and emptied of product daily, such as milk rooms and terminal storage warehouses.

You get true trouble-free refrigeration . . . No brine . . . no salt solution . . . no dirt . . . no mess . . . It is entirely clean; you get rid of dirt and odors. You reduce both equipment and operating costs.

For complete information write to the Niagara Blower Company, Dept. ME, 405 Lexington Avenue, New York 17, New York.



A simple method, easily maintained. Saves a third of your refrigeration cost. Ask for Niagara Bulletins 118 and 119.

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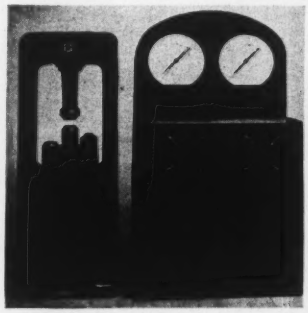
The new testing machine is similar in operation to the 90,000-lb machine which it replaces. It is designed primarily for testing 2-in. cubes and 3-in. × 6-in. cylinders, but the stroke and dimensions of the working space are large enough to permit many other uses.



The loading unit has a clear space of 17⅝ in. between columns and a maximum opening of 22¼ in. between ram and upper platen. Ram travel is 3 in. at speeds up to 1¼ in. per min. The loading rate is controlled by means of a pacing indicator and manually operated valve which varies the pump discharge to the hydraulic loading cylinder. Load can be increased at a constant rate of 4000 psi per min on 3-in. cylinders and 2-in. cubes when operating on the 100,000-lb dial; and at 4000 or 1000 psi per min on 2-in. cubes when operating on the 10,000-lb dial.

The ranges provided on the two 16-in.-diam dials, 0–100,000 and 0–10,000 lb, are graduated in 200-lb and 20-lb increments respectively. The hands are driven by Emery precision Bourdon tubes activated by an independent Emery cell built into the loading ram. Accuracy of load measurements is within plus or minus 1 per cent at indicated load or 0.2 per cent of full-scale capacity, whichever is greater.

Floor area required by the two units is approximately 70 × 20 in. Over-all height is 65 in.

Airport Runway Lights

The U. S. Air Force has ordered 4000 new-type airport runway lights developed by Westinghouse Electric Corp. Lighting Div. in Cleveland, Ohio.

The new lights have a one-piece glass lens that distributes light in a 360-deg circle around the unit in a definite pattern. The new multiple lens was described as an oversized thimble, flattened on two sides. The flat sides are lenses that project a high candlepower beam of light up and down the airport runway to outline the strip to the incoming pilot.

The curved side of the unit that faces away from the runway distributes high intensity light fanwise through a 180-deg arc to indicate to circling pilots the direction and orientation of the runway. The fourth side of the glass lens—the portion that faces the runway itself—permits only a minimum amount of light to pass through it, so that it will not distract or interfere with the pilot's vision as he passes the unit.

This new runway light uses a 200-watt lamp and is equipped with a 200-watt insulating transformer. As a safety feature, a breakable coupling is installed between the column supporting the unit and the base

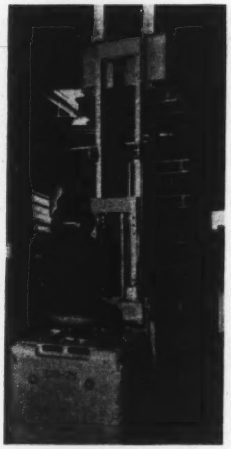
• Keep Informed

plate. This coupling will break if the unit is struck by a taxiing plane or other vehicle, thus minimizing possible damage to both the plane and the runway light. Shipment of the first of the 4000 units ordered by the Air Force already has begun.

Materials Handling

Serviced by a fleet of 110 mechanized industrial trucks, 82 of which are powered by storage batteries, York Corp., manufacturers of air-conditioning and ice-making machines for home and industry, has all but done away with manual methods of handling and storage at its two big manufacturing plants and its shipping center and warehouse in York, Pa. Use of battery-electric industrial trucks by York dates back to 1920 when its first units were installed.

Both in the West York and the newer Grantley plant of the corporation, intensive use is made of battery-electric trucks, mostly of the "heavy-duty" fork and platform types. Approximately half of the units are used for two full shifts, the remainder being used but a single shift. In the shipping warehouse fork trucks also are used in handling operations. Considerable use is made, in all three locations, of the hand-type of battery-electric-powered industrial truck. Nineteen of these latter are of the platform type, 15 are pallet-handlers while five are of the type utilizing pallets in stacking operations.



Some use also is made of gasoline-powered trucks, there being seven each of the fork, low-lift platform and high-lift platform types, while three gas-electric trucks also are used. Four trucks of miscellaneous types are also used in various spots around the plant areas. In the handling of foundry items such as facings, cements, steel shot, sand for blasting, etc., the gas trucks find their greatest applications, although several of the gas-powered fork trucks are used in warehousing operations to handle material primarily in the areas immediately adjacent to the shipping/receiving docks.

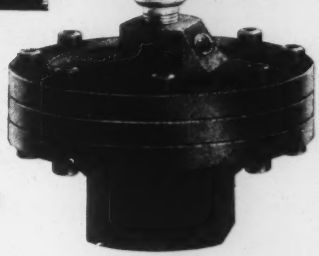
It is in the handling of materials cased for shipment at the Grantley Plant that the greatest use is made of the battery-electric fork trucks. Second comes their use in the West York plant in the handling of incoming items such as steel-strapped unit loads of electric motors; in the removal and storage of

Continued on Page 52

HELICOID
Chemical Gage

Standard dials: 0-15, 30, 60, 100, 150, 200, 300, 400, 500, 600, 800, 1000, 1500, 2000, 3000. Also 0-30" vac., 15 and vac., 30 and vac., 60 and vac.

Supplied with Cartridge Snubber in socket for pump service.

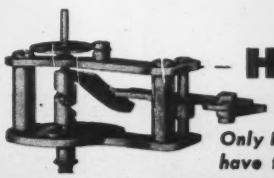


Bronze
Cast Iron
Lead Coated Iron
Steel
Stainless Steel (316)
Monel
Hastelloy B
Hastelloy C
Dural (24 S-T)
Carpenter No. 20 (Duramet)
Nickel
Everdur
Hard Rubber

● Here's a chemical gage for any pressure to 3,000 p.s.i. and also for vacuum or compound ranges, and temperatures to 300° F. Particularly suitable for chemicals and other viscous liquids that either corrode or clog a Bourdon tube gage.

One feature of this Chemical Gage is that the diaphragm is made of "TEFLON" which is flexible and resists practically all corrosive chemicals. No fragile metal foils are used. The diaphragm chamber is supplied of any metal most suitable for the service.

Available in the following dial sizes: 4½", 6", or 8½". 1" female N.P.T. bottom connection. Flanged connection also supplied.



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ACCO

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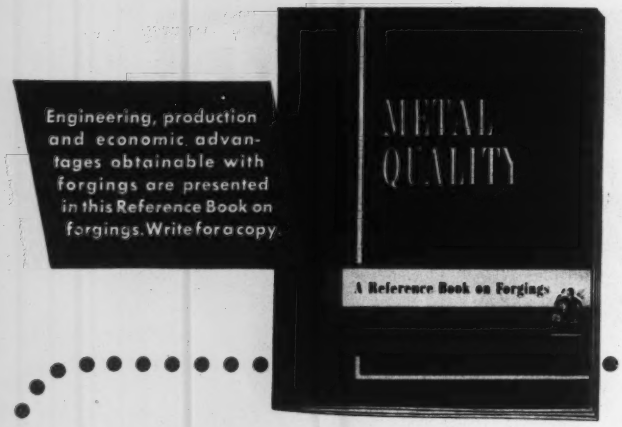
HELICOID GAGE DIVISION
AMERICAN CHAIN & CABLE COMPANY, INC.
Bridgeport 2, Connecticut


Engineering, production and economic advantages obtainable with forgings are presented in this Reference Book on forgings. Write for a copy.
METAL QUALITY
A Reference Book on Forgings

Never underestimate the preference of users of your product for the factor of greater safety that is inherent in forgings. This factor of greater safety results from toughness and strength, in correct proportion, as found only in closed die forgings. Consult a forging engineer about the mechanical properties required for your product.

DROP FORGING ASSOCIATION
605 HANNA BLDG. • CLEVELAND 15, OHIO

Please send 60-page booklet entitled "Metal Quality — How Hot Working Improves Properties of Metal", 1949 Edition.

Name .....
Position .....
Company .....
Address .....

• Keep Informed

heavy dies used by the sheet metal division, and in the handling and storing of assembled units, or component parts, of hermetic compressors.

Two sizes of pallets are used for general handling. One is a two-way wooden pallet, 42 × 36 in., the other a "half-pallet" the dimensions of which are 21 × 36 in. Some pallets are of the stevedore type permitting handling at the ends by a truck's widely extended forks, or by rope or wire slings, if need be. A special department with day and night crews, service all trucks and batteries, and the battery charging room is fitted with modern equipment permitting easy handling during battery changes.

Special Machine Tool

One hundred cylinder blocks per hour are drilled, tapped, spot-faced, and reamed on a new machine designed and built by The Cross Co., Detroit, Mich. The machine is made up of 13 stations with parts automatically moving from station to station. Only one unskilled operator is required.

The operations include drilling, chamfering, and tapping holes in the top and bottom; chamfering the cylinder bores, top and bottom; drilling oil holes from crank bearings to oil gallery; drilling, rough boring, semi-finish boring, and spot-facing the distributor shaft hole; and drilling, chamfering, and reaming the dipstick hole.

A cleaning unit situated at Station 11 vibrates and rotates the cylinder block at 360 deg to remove all chips from the holes before inspection and tapping. At Station 12, an automatic inspection unit stops the machine if the holes are not drilled to the proper depth for tapping. A special coolant system is used to flush the taps. A built-in oscillating-type chip conveyer removes all chips.

Hydraulic and electrical installations are to J.I.C. standards. Stranded wires are used throughout. The machine is automatically lubricated with each cycle.

Other features include hardened and ground ways and the use of standard Cross units to facilitate maintenance, reduce downtime, and provide flexibility for part design changes.

• Keep Informed

Valve Actuators

Designed for the operation of gate valves, plug valves, dampers, diaphragm valves, butterfly valves, and sluice gates, and developed as a standard product, is a line of valve actuators, just introduced by Ledeen Mfg. Co., Los Angeles, Calif., and described in bulletin No. 512.

The valve actuators are basically Ledeen cylinders, equipped with brackets, valves, controls, and couplings to make them suitable for almost any type of operation required. They can be adapted to any make, size, and type of valve; to operate against any line pressure; to work on any fluid medium, and with any pressure available. They can be arranged for on-and-off service, or for positioning service.

Typical valve actuator circuits, capacities of valve actuators, and details of construction, application, and control are given.

• BUSINESS CHANGES

Standard Stoker Co. Changes Name to Read Standard Corp.

The Standard Stoker Co., Inc., has changed its corporate name to Read Standard Corp. This is a change in name only. There has been no change in ownership, management, or personnel.

The company has diversified its activities in the past several years. Present products include standard stokers for railroad and industrial use, Readco bakery machinery and ovens, Readco chemical processing equipment and axial-flow positive pressure Standardaire blowers for varied industries.

Operations under the new name are separated into two major divisions, namely: the Bakery-Chemical Div. and the Blower-Stoker Div. The divisional operation heretofore designated as Read Machinery Div. is now to be known as the Bakery-Chemical Div.

The Bakery-Chemical Div. at York, Pa., will be manufacturing, engineering, and sales headquarters for the Readco line of bakery and chemical equipment. The Booth plant at Los Angeles will be headquarters for west coast operations of this division. The Erie, Pa., plant will be manufacturing and engineering headquarters for the Blower-Stoker Div. with sales headquarters at New York. Executive and divisional sales offices will be maintained as heretofore at New York.

S K F Advertising Manager Appointed

Norman A. Strang has been appointed advertising manager of S K F Industries, Inc., Philadelphia manufacturers of ball and roller bearings. He succeeds Robert C. Byler, who died on March 27, from a heart attack.

Westinghouse to Build New Tube Plant

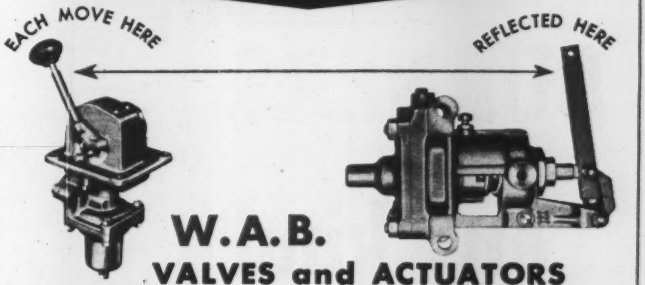
The Westinghouse Electric Corp. has announced plans for construction of an electronic tube manufacturing plant on a 70-acre site in Bath, N. Y.

This plant, which will make Westinghouse the largest manufacturer (approximately 2000 employees) in the 15-mile area surrounding Bath, will produce electronic tubes for the Armed Services and for essential industries. After the national emergency, conditions permitting, the plant will be converted—and rebuilt if necessary—to produce tubes for radio receiving sets and for television sets. Automatic machinery is now being constructed for this plant and it will be available for installation as soon as the building is completed.

Got any Problems That Call for

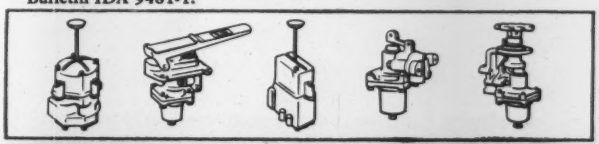
THROTTLING
GRADUATING
POSITIONING
} CONTROLS?

Here's your Answer...



W.A.B.
VALVES and ACTUATORS

The smallest move of the control-valve handle is "echoed" by proportional movement of the actuator to throttle engines, graduate flow in process operations, positioning actuator to modulate fuel feed to boilers, etc. Eliminates complication and maintenance of mechanical linkage. Only connection is an air tube. Place controls at any distance from operation, centralize command of multiple operations. Hand, foot and cam operated valves available. Ask for Bulletin IDA 9481-1.



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AIR BRAKE COMPANY
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Distributed in Canada by: Canadian Westinghouse Co., Ltd. Hamilton, Ontario

Allis-Chalmers Names New Sales Representatives

Newly named Allis-Chalmers general machinery division sales representatives to five north central states are Arthur E. Schnaufer to the company's Duluth office; Robert R. Maxwell, Davenport; R. F. Kinney, Kansas City, Mo.; John T. Petersen, Cleveland; William H. Davis, Cincinnati; William R. Carlyon and Clare K. Tubbs, Detroit; and Jack H. Doty, Jackson, Mich.

Newly named Allis-Chalmers general machinery division sales representatives to two eastern states are Charles Watson, to the company's Boston district office; Donald A. Wooley, New York; and Robert W. Butterworth, Syracuse.

Newly named Allis-Chalmers general machinery division sales representatives to four southern states are John E. Watson to the company's Birmingham district office; James P. Boger, Charlotte; Stephen Hogg, Jr., Atlanta; and Wilson O. Vaughn, Richmond.

Loren D. Barre has been assigned to the Allis-Chalmers general machinery division Portland district office as a sales representative.

It was also announced that Charles W. Bloedorn has been named southeast regional representative for Allis-Chalmers steam turbine department effective May 1 with headquarters in Atlanta, Ga.

Ehret and Kinsey Expand

Ehret and Kinsey, Chicago, Ill., sales representatives of the Cleveland Worm and Gear Co. and the Farval Corp., moved to new quarters in the Board of Trade Building, 141 West Jackson Blvd., as of May 1, 1951.

Continued on Page 54

PEABODY BURNERS for any kind of fuel

LIQUID

Acid Sludge
Water Gas Tar
Oil Gas Tar
Alkaline Sludge
Pitch

GAS

Refinery Gas
Coke Oven Gas
Blast Furnace Gas
Hydrogen Sulphide Gas
Sewerage Gas
Mercaptans

SOLIDS

Petroleum Coke
Oat Hulls
Saw Dust
Furfural

Peabody Engineers have analyzed and successfully solved hundreds of unusual combustion problems throughout the world involving many widely varying types of liquid, gaseous and solid fuels. Continual research and development make Peabody Burners the *preferred* equipment — dependable, satisfactory and trouble-free. Each installation is custom-engineered to meet specific operating requirements and its satisfactory performance is assured by more than 30 years of successful combustion experience. Inquiries on combustion problems of any kind are always welcomed. No obligation.

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ENGINEERING CORPORATION
580 FIFTH AVENUE • NEW YORK 19, N. Y.
Manufacturers of all types of combustion equipment, direct fired air heaters, gas scrubbers, coolers, and absorbers

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PEABODY LIMITED • LONDON, S.W.1, ENGLAND

769

• Keep Informed

Westinghouse Expansion Boosts Generator Production Capacity 65 Per Cent

Plans are under way for two new East Pittsburgh buildings of Westinghouse Electric Corp. that will increase by 65 per cent the capacity to produce giant electric generators.

The new structures will provide more than 300,000 extra sq ft for large generator production. This will make possible construction of larger than 150,000-kw high-speed 3600-rpm generators.

Three old buildings, one of them the Meter Works building on Braddock Ave., are being razed to provide room for the new structures. In place of the old, the new will be: (1) Section D Annex building—large generator production aisle; (2) shipping and warehouse building.

The 1000-ft D Annex, which will be adjacent to the present D-aisle, but with the intervening wall removed, will house two high-level 200-ton cranes (66 ft above the floor) that can team up to carry as much as 350 tons. Below these, 45 ft above the floor, will be three 50-ton cranes that will handle "small stuff."

The new four-story shipping and warehouse building, which will front on Braddock Ave., will have five electrically operated tramrail cranes on the first floor and two on the second to expedite materials handling. Reversible rubber-belt conveyers will carry the bulk of smaller materials to all floors. Portions of the third and fourth floors will be used for offices.

The construction contract for the D Annex, to be completed by 1953, but in production by 1952, and the shipping and warehouse building, to be completed by November, 1951, has been awarded to the Stone and Webster Engineering Corp. Most of the work will be subcontracted to Pittsburgh area firms.

G-E Establishes New Aircraft Service Facilities

New aircraft equipment service facilities have been established at two General Electric Service centers in Los Angeles and Dallas to provide overhaul and modification of the J-47 jet engine and the B-36 remote-control turret systems.

The new facilities, part of the G-E program to provide up-to-date modification and service on all aircraft components in order to meet the requirements of actual flight operations, will be an important link in the coordination of the manufacturer to operator process.

At Los Angeles, new service facilities have been established adjacent to the main service shop as a permanent part of G-E's service facilities in Los Angeles.

This shop, which handles the overhaul and modification of the J-47 turbojet as well as armament overhaul and instrument repair, will be instrumental in eliminating delays involved in returning the jet engines to G-E's manufacturing plant in Lynn, Mass., and Lockland, Ohio, for special Air Force modifications. Featuring the latest design improvements in tools and fixtures, the California center has already serviced hundreds of jet engines, including special units modified for research and development programs at Edwards Air Base, Muroc, Calif.

The facilities in Dallas have been established for the modification and overhaul of the B-36 fire control system and are designed to make modifications resulting from early flight tests and flight experience. These new service facilities are located in G-E's Dallas service shop.

• Keep Informed

Worthington Breaks Ground For Its 20th Plant

Ground was broken recently at Succasunna, N. J., for a vertical turbine pump plant of Worthington Pump and Machinery Corp. by C. E. Wilson, vice president in charge of sales of vertical turbine pumps.

The one-story building, measuring 80 × 200 ft, will be constructed by the Lawrence Construction Co. of Union, N. J. Water supply for the fire-protecting sprinkler system will be furnished by the very product to be manufactured in the finished plant—a Worthington vertical turbine pump. In addition, office space will be air conditioned by Worthington equipment.

The unit-type construction will contain several bridge-type traveling cranes and will be used primarily for warehousing and assembly work. Small-capacity machining facilities will be used at the start. There will be an engineering room at the plant, as well as a test stand for simulating field conditions to check the mechanical and hydraulic phases of the equipment prior to shipment.

Robert C. Tierney, formerly co-ordinator in the vertical turbine pump division of Worthington Pump and Machinery Corp. at Harrison, N. J., will be in charge of the corporation's new vertical turbine pump plant at Succasunna, N. J., when it is completed. This was announced by L. C. Ricketts, vice president in charge of manufacturing.

Koppers to Build New Coke Battery for Crucible Steel

Koppers Co., Inc., Pittsburgh, Pa., will design and build a new battery of 29 coke ovens at the Midland, Pa., plant of Crucible Steel Co. of America, it was announced recently.

The new battery of 29 Koppers-Becker combination coke ovens will carbonize 490 tons of coal per day and will be underfired with either coke oven or blast furnace gas.

Included in the contract are changes and additions to the chemical recovery equipment at the Midland coke plant.

Crucible Steel at present operates four batteries of 184 Koppers ovens at Midland.

Taylor Celebrates 100 Years of Instrument Making

This year marks the 100th birthday of the Taylor Instrument Companies of Rochester, N. Y. Starting as a tiny partnership for making household thermometers and barometers, the business of Kendall & Taylor showed an inventory in 1851 listing total assets at $919, of which $600 was for "knowledge of the business." The company has since become a multimillion dollar corporation manufacturing some 8000 variations of its basic products and distributing them all over the world.

Although instruments for consumer use comprise the oldest part of the present Taylor line, by far the largest is the industrial instrument division, which began in 1896 with the acquisition of a firm making mercury-in-glass industrial thermometers for use on such batch processes as brewing, varnish making, and printing ink. In 1905, the first controllers were added to the industrial line, an event which marked a highly significant turning point in the flowering of continuous industrial processing in this country. The continuous processing of chemicals, photographic film, textiles, foods, milk, plastics, and other synthetics, petroleum, paper, etc., now requires such involved and precise control that to return to hand methods would literally bring the American economy to a standstill until the old-fashioned methods of batch processing with its hand-operated

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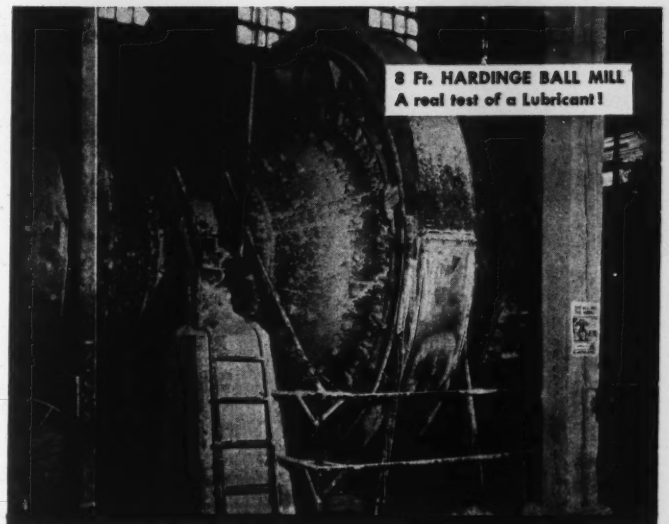

"LUBRIPLATE No. 630-AA is practically a universal lubricant"

"**Lubriplate Lubricants** enabled us to cut the number of lubricants we were using to about half, but even then we were still using five different LUBRIPLATE Products. With the introduction of LUBRIPLATE No. 630-AA, we were able to reduce our requirements still further. Today we are satisfying all our needs for solid type lubricants with only two LUBRIPLATE Products. LUBRIPLATE No. 630-AA might almost be considered a Universal Lubricant. Furthermore, LUBRIPLATE No. 630-AA has effected a marked savings in lubricants and labor."

Frank D. Neill
General Superintendent

SIMPLIFY YOUR LUBRICATION SCHEDULE

Lubriplate Lubricants set new high standards: They reduce friction, wear and power consumption. They prevent rust and corrosion of bearings, parts and product. They last longer than ordinary lubricants. LUBRIPLATE Lubricants are available from the lightest fluids to the heaviest density greases to meet all conditions, usual and unusual. Write for case histories of the use of LUBRIPLATE in your industry.

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DEALERS EVERYWHERE . . . CONSULT YOUR CLASSIFIED TELEPHONE BOOK

LUBRIPLATE *THE MODERN LUBRICANT*

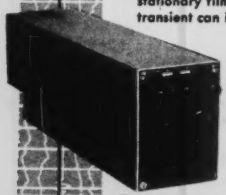
THE HATHAWAY SC-16A SIX ELEMENT
RECORDING CATHODE-RAY OSCILLOGRAPH

NEW HIGHS IN RESOLUTION are obtained by this new oscillograph because of its unusually HIGH FREQUENCY RESPONSE and HIGH CHART SPEED...designed for recording fast transients and continuous phenomena.

FREQUENCY RESPONSE 0 to 200,000 cycles per second
RECORDS up to 1000 ft. long at speeds up to 600 inches per second
RECORDS up to 10 ft. long at speeds up to 6000 inches per second
WRITING SPEED as high as 5,000,000 inches per second

Note these additional unusual features.

- SIX ELEMENTS with convenient interchangeable lens stages for 1, 2, 3, or 6 traces on full width of chart.
- INTERCHANGEABLE RECORD MAGAZINES for CONTINUOUS RECORDING on strip chart, either 6 inches or 35mm in width up to 1000 feet in length, DRUM RECORDING for short, high-speed records, and STATIONARY CHART for very short transients.
- PRECISION TIMING EQUIPMENT, tuning fork controlled, for 1-millisecond or 10-millisecond time lines.
- Crystal-controlled Z-AXIS MODULATION for 1/10 millisecond time marks.
- QUICK-CHANGE TRANSMISSION for instantaneous selection of 16 record speeds over a range of 120 to 1.
- AUTOMATIC INTENSITY CONTROL.
- CONTINUOUS SWEEP OSCILLATOR which permits viewing as well as recording.
- Single-pulse LINEAR OSCILLATOR for recording transients on stationary film. The record can initiate the transient to be recorded, or the transient can initiate the record.



Each recording element is a complete unit, fully housed, which can be instantly inserted or removed. Recording element contains high-intensity cathode-ray tube, and both AC and DC amplifiers. Control panel is located on outside end.

FOR FURTHER INFORMATION, WRITE FOR BULLETIN 2G1-K

Hathaway
INSTRUMENT COMPANY
1315 SO. CLARKSON STREET • DENVER 10, COLORADO

• Keep Informed

valves could be installed. Quality, uniformity, and manufacturing costs would also revert to the standards of a quarter of a century ago, and many products could not be made at all.

Ever since it made a contract with the U. S. Navy just prior to the Spanish-American War, Taylor has been contributing significantly to the defense of the nation. During World War II such vital processes as synthetic rubber and high-octane gasoline couldn't have met production schedules without the kinds of control equipment made by Taylor.

Taylor's record in the design and development of industrial instruments is such that the company was chosen prime contractor in the development, design, and manufacture of all process control instruments for the Gaseous Diffusion Plant of the Atomic Bomb Project at Oak Ridge, Tenn. Many carloads of these unbelievably precise instruments control the processes of that vast plant.

The tiny thermometer company of 1851 is now the largest instrument company of its kind in the world, serving the home, the medical profession, and industry with instruments to indicate, record or control temperature, pressure, flow, force, liquid level and humidity. Branch offices cover the country, and the manufacturing facilities of subsidiaries in Canada and England serve other parts of the world.

New President for Roots-Connersville

Robert H. Owens has been elected president and general manager of Roots-Connersville Blower Corp., Connersville, Ind., one of the Dresser Industries, succeeding John Avery who died unexpectedly on January 13, 1951.

Ralph R. Newquist, who became vice-president in charge of sales for Roots-Connersville in May of 1946, has been elected executive vice-president.

Promotions of E. P. Roudebush to works manager, in charge of all production activities, D. A. Johann to sales manager, in charge of all sales and advertising activities, and A. E. Caudle to assistant sales manager, were also announced.

Radar Contract Awarded to Westinghouse

An $8,500,000 contract for the production of radar equipment for the Navy has been awarded to the Westinghouse Electric Corp., Springfield, Mass. The contract is for search-type radar sets, recently designed by Westinghouse electronics engineers at Baltimore, Md., who worked in co-operation with Navy experts.

Tooling and other preparations for manufacture of the sets has already started. The project—the plant's first major defense production contract—will be carried on in an area now used as a warehouse, so current production of electric appliances will not be affected.

S-K Co. Consolidates Offices

Schutte and Koerting Co., manufacturing engineers, on the occasion of their 75th Anniversary, announce the consolidation of general offices and manufacturing facilities in one location in an enlarged modern plant at Cornwells Heights, Bucks County, Pa.

General Offices and some light manufacturing were formerly located at 12th and Thompson St., Philadelphia.

The new works afford opportunities for consolidation of activities, sufficient room for greater expansion, and an increased ability to serve industry better, faster for many years to come.

• Keep Informed . . .

New Assembly Building Adds to Foxboro's Main Plant

A new one-story building, now nearing completion, will add 50,000 sq ft, or an increase of nearly 25 per cent, to the working area in the headquarters of the Foxboro Co., Foxboro, Mass., makers of industrial instruments for measurement and control. It is so located as to be a connection, on the same floor level, between the present factory buildings and a new steel and aluminum warehouse, 50 × 200 ft, recently completed.

The new building will be used principally for the final assembling and testing of recorders and controllers for temperature, pressure, liquid level, and flow; and the transfer of these operations from the older buildings to the new one will permit expansion of departments which produce electronic and electric instruments and control equipment of other descriptions.

In addition to the new assembly building and the warehouse a new training school building is being erected, adjacent to another group of the company's buildings across the street.

National Airoil Announces New Chemical and Petroleum Division

The National Airoil Burner Co., Philadelphia, Pa., has announced the formation of their Chemical and Petroleum Div. Mr. William Ferguson, vice president, heads the new division which comprises a group of engineers widely versed in meeting the combustion, furnace, and related problems of the chemical and petroleum industries.

The technical staff of the Chemical-Petroleum Div. is under the direction of Mr. Frederic Bauer, chief technologist, who has been specializing in the chemical-petroleum industries' process heating problems for a major part of his career.

The mechanical engineering staff will be directly under the supervision of Mr. John J. Griffin, chief engineer.

Koppers to Construct Plant at Fontana, Calif.

Koppers Co., Inc., Pittsburgh, Pa., has taken an option on 158 acres of land at Fontana, Calif., and contemplates construction of a plant there for the making of enamel pipe coatings and roofing materials, according to a recent announcement.

The proposed site is adjacent to the Kaiser Steel Co. plant and Koppers plans to use pitch made from tar obtained from Kaiser coke ovens, processing it into high-grade enamels for pipe coatings and various types of roofing materials. A contract with Kaiser providing an adequate supply of the pitch has been arranged.

If plans go through as anticipated, work on the new plant will be started as soon as possible and it will be in operation before the end of the year.

Johns-Manville Names Two Managers

C. A. de Vyver, Cherry St., Katonah, N. Y., has been appointed manager for insulations of Johns-Manville, it was announced recently by F. J. Wakem, merchandise manager of the Industrial Products Division and vice president of Johns-Manville Sales Corp.

Mr. Wakem also announced the appointment of Duane D. Crews, 10 Tappan Landing Rd., Tarrytown, N. Y., as manager of construction of the J-M Industrial Products Div.

Continued on Page 58

All These Were Once

DUST COLLECTION PROBLEMS, TOO

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203 Metallurgical Installations
205 Acid Plants • 40 Paper Mills
270 Delarring Installations
216 Power Stations
73 Steel Plants • 99 Oil Refineries
and Miscellaneous Installations

Your electrical precipitator installation will be individually engineered...and based on the Research Corporation's *experience* graphically shown by that towering pile of thousands of blue prints.

This knowledge is a valuable asset that will help Research engineers to "tailor-make" your Cottrell installation. For example, they can more quickly determine the right answers to such variables as the size, shape and type of both discharge and collecting electrodes, their relative spacing, flue arrangements and many other factors. At Research you can count on *profitable solutions to individual problems.*

Research Corporation Cottrells can be made as efficient as you desire. They can collect 95% to over 99% of all solid or liquid particles suspended in gas entering equipment. Write for free booklet giving valuable data. RC-121

Typical One Day Collections

• 250 TONS OF FLY ASH
• 5500 POUNDS OF CONCENTRATED SULPHURIC ACID
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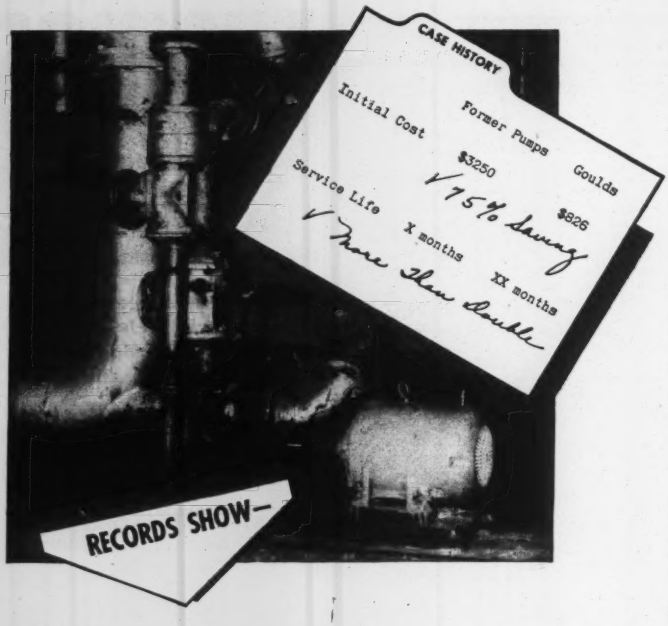

How a manufacturer cut costs tremendously with Goulds stainless steel pumps . . .

When handling corrosive liquids, pumps alone can be an important item in your processing budget. One alert plant engineer in the southwest cut his pump costs to about an eighth of what they had been.

The pumps he had been using for an especially erosive crystaline slurry cost $3250. When they wore out he replaced them with Goulds Stainless Steel Centrifugals for only $826. But this tremendous saving in initial cost was only half the pay-off. The Goulds pumps have already been in service *twice as long* as the ones they replaced . . . and they're still going strong.

The advanced design and simple construction of Goulds pumps make these savings possible. Bearings are prelubricated and fully protected. Stuffing boxes are under suction pressure to prevent leakage and assure long packing life. Parts are interchangeable. The impeller clearance can be adjusted for wear. Available in 9 sizes with capacities to 750 G.P.M. Send us the coupon today for full details.

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• Keep Informed

Koppers to Build Blast Furnace and Coke Battery in Brazil

Koppers Company, Inc., Pittsburgh, Pa., has been authorized to design, engineer, and supervise the construction and initial operation of a blast furnace and a battery of chemical-recovery coke ovens for the Brazilian National Steel Co. at Volta Redonda, Brazil, according to a Koppers announcement.

Work on the new 25-ft hearth diameter blast furnace, which will double the potential pig-iron capacity of the Brazilian plant, will be done by Koppers Freyn Engineering Department, of Chicago, Ill.

The new battery of 21 Koppers-Becker underjet coke ovens, which may be underfired with coke oven, blast furnace, or producer gas, will carbonize 612 tons of coal per day and increase the carbonizing capacity of the Volta Redonda coke plant from 1600 to 2212 tons per day.

Included in the contract with Brazilian National Steel are additions and alterations to the coal-chemicals plant to accommodate the additional capacity from the new battery of ovens.

Koppers completed the original battery of 55 ovens and the coal chemicals plant at Volta Redonda in April, 1946.

Materials for the new blast furnace and coke ovens will be procured in both the United States and Brazil.

• LATEST CATALOGS

Tippet & Wood Catalog

Please note that the supply of Catalogs offered in item No. 132 in the April 1951 issue of "Buyer's Catalog Guide" has been exhausted. Your direct inquiries in the meantime are most welcome.

TV Transmitting Equipment

Several new equipment bulletins are available from the Television Transmitter Div. of Allen B. Du Mont Laboratories, Inc., Clifton, N. J., to any one interested in telecasting operations or plans. These bulletins describe in detail the latest products of the division, including operational features, engineering data, illustrations, and diagrams of interest to the station manager, engineer, and planning personnel.

Among these new Du Mont bulletins are: The Universal Color Scanner, Master Control Switch Unit and Master Control Mixer Amplifier, Universal Console, Linearity Bar Generator, and several others covering a wide range of TV transmitting equipment and accessories.

Megger Insulation and Low Resistance Testers

The midget megger insulation tester, the CVM constant voltage type, and the midget megger circuit testing ohmmeter, are all fully described in a new bulletin, issued by James G. Biddle Co., Philadelphia, Pa.

Engineers, electricians, and electrical inspectors and maintenance men will appreciate the time and trouble-saving advantages of these efficient, easily portable electrical resistance testing instruments.

Miniature Ball Bearings

A new 12-page catalog on miniature ball bearings has just been issued by Miniature Precision Bearings, Inc., Keene, N. H.

Containing complete specifications on more than 70 different types and sizes of miniature ball bearings, it includes details on typical applications of these bearings and photographs and diagrams of current installations in various fields.

• Keep Informed . . .

Piping Fabrication and Erection

To demonstrate its experience and facilities for fabrication and erection of industrial piping, Dravo Corp., Pittsburgh, Pa., has made available a 24-page illustrated booklet, Bulletin No. 1700. Its many pictures show piping installations in steel mills, for gas-transmission systems, central power stations, water-pumping stations, heating plants, oil refineries, and chemical process plants. Dravo's engineering and fabrication facilities are also illustrated and described.

Conveyer Chain

A new type of conveyer chain, known as Rex Flex Top, is described in a bulletin, No. 51-59, just released by Chain Belt Co., Milwaukee, Wis. The new chain is of the "flat-top" type, but its construction is such that it can flex in two planes, horizontal and vertical, and can curve around the sharpest corners with ease.

Rex Flex Top's biggest advantage is its elimination of transferring containers from one conveyer to another.

The Flex Top conveyer chain bulletin contains pictures and specifications.

SR-4 Load Cells

A new 2-page bulletin, No. 324, describes, illustrates, and gives specifications for a new line of seven type "U-1" SR-4 universal load cells ranging in weighing capacity from 500 to 50,000 lb in tension and compression. The cells depend upon electrical resistance measurements of SR-4 resistance wire strain gages bonded to the steel column. Copies are available from Baldwin-Lima-Hamilton Corp., Philadelphia, Pa.

Carbide Tooling

A new catalog No. 51 issued by Kennametal Inc., Latrobe, Pa., gives specifications and prices of the most complete line of cemented carbide tools ever offered. These tools are segregated in sections of the catalog and graphically indexed, for ready reference, on inside front cover.

Valuable data on Kennametal and its diversified applications as a cost-cutting material are also presented.

Measurements Laboratory

A 16-page, two-color brochure describing the varied facilities of, and the work conducted in, the new $2,000,000 Measurements Laboratory of the General Electric Meter and Instrument Divisions at Lynn, Mass., is available from General Electric Co., Schenectady, N. Y.

The booklet, GED-1406, shows pictorially how the laboratory's corps of specialists conducts research into new ways to measure; develops new materials and devices; tests them for reliability and accuracy; evaluates manufacturing processes; maintains accuracy standards, and checks products off the production lines.

The book also covers the wide range of mechanical and electrical services and test facilities available to engineers and technicians working in the laboratory.

Regulators

A bulletin just published by Spence Engineering Co., Inc., Walden, N. Y., covers pressure regulators, temperature regulators, and self-cleaning strainers. Included are specifications on main valves, capacity and flow data, dimensions and weights.

Refrigeration Compressors

Detailed description of the 2, 3, 5, and 7½-hp hermetically sealed refrigeration compressors and condensing units is given in a new bulletin available from the Westinghouse Electric Corp., Sturtevant Div., Boston, Mass.

Features of the types CLS-74, -110, -188, and -282 compressors and condensing units are described in detail and illustrated. Complete specification data are given.

Dust Precipitators

The latest design of dust precipitators made by American Blower Corp., Detroit, Mich., is described in a new catalog.

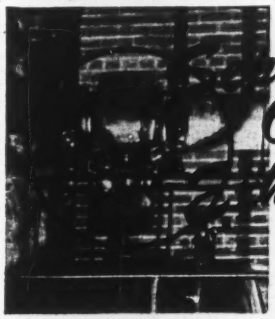
The line is referred to as the Series 342 Precipitator and is designed to handle fly ash, cinders, and industrial dusts. It has been developed to meet the need and demands of industry for a simple, compact, economical, all-purpose mechanical-type Dust Precipitator.

The unit is built in a range of standard sizes with two basic arrangements and can be modified to fit special requirements. The unique design of the unit simplifies field erection as it can be shipped in factory-assembled sections which are all match-marked for final erection and assembly.

Ship Gratings and Treads

A new pamphlet recently issued by Irving Subway Grating Co., Inc., Long Island City, N. Y., contains safeload tables, weights, panel widths, various types and sizes of mesh, etc., as applied to gratings and treads for merchant and naval vessels.

Continued on Page 60



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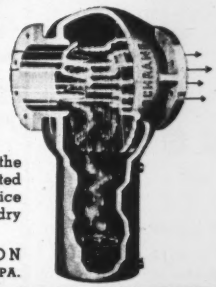
Where exhaust steam is used for heating and deaerating feed water, the oil usually present in the exhaust may be practically eliminated by installing a Cochrane All-Service Separator on the inlet pipe. Clean dry steam is assured.



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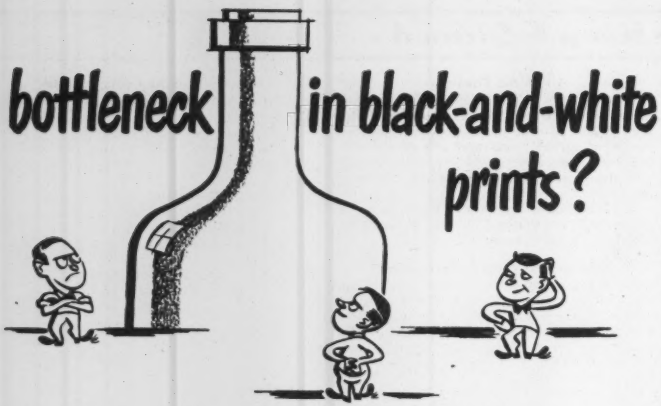

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• Keep Informed

Cutting Handling Costs

"How to Build Profits by Cutting Handling Costs," is the subject of a new chain conveyer bulletin just published by Chain Belt Co., Milwaukee, Wis. The book stresses the importance of careful selection of chain conveyers in the instances where they apply.

Chain conveyers are comparatively lightweight, yet exceptionally sturdy. They may be vertical or horizontal and operate at floor level or at any desired working height. They often eliminate the need for wide aisles and extensive storage space around machines.

While Chain Belt's book on conveyer chains and attachments shows numerous examples of chain conveyer application, it is intended to be more of a "thought-provoker" than a detailed catalog, and is very apt to suggest an answer to your question, "What is the correct method for conveying or handling my product?"

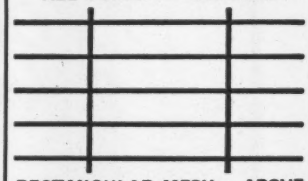
Hydraulic Equipment

A new catalog, M-5100, issued by Vickers Inc., Detroit, Mich., should be of interest to all types of mobile equipment manufacturers. Specifications, charts, and design details are given for oil hydraulic power packs, pumps, new series multiple unit valves, steering boosters, and motors.

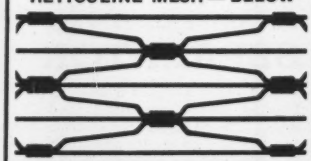
Air Filter Gages

A new bulletin, No. 114, published by Ellison Draft Gage Co., Chicago, Ill., describes Ellison inclined draft gages for application to ducts at point where air filters are installed, to check air flow resistance. Bell-type dial gages for this application are also described. Installation diagrams are given.

GRATING-FLOORING and STAIR TREADS
ALL TYPES — ALL SIZES



RECTANGULAR MESH — ABOVE or RETICULINE MESH — BELOW



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• Keep Informed

Tension Linkages

Baldwin Duckworth, Div. of Chain Belt Co., Milwaukee, Wis., manufacturers of Baldwin Rex roller chain, have just released an informative handbook for designers of tension linkages.

The term "tension linkage" as used in this book describes any chain application in which linear movement of the chain is not continuous in direction. The predominating feature of a tension linkage is that the chain need not be an endless belt as in a power transmission drive. Numerous examples of tension linkages are shown and described in this bulletin. Various types of roller chains used in tension linkage applications are illustrated, described, and cataloged.

Expansion Joints

Zallea Bros., Wilmington, Del., announce publication of a new 4-page bulletin, No. 351, describing the complete line of Zallea expansion joints. Sizes, dimensions, suggested applications, and other technical data on a variety of joints from small flexible connectors for use on Diesel exhaust lines to 30-ft-diam self-equalizing joints for use in such applications as wind tunnels, etc., are given.

Freon Coolers

Patterson-Kelley Co., Inc., East Stroudsburg, Pa., manufacturers of refrigeration and heat-exchange equipment, has just issued a 12-page illustrated catalog devoted to freon or ammonia coolers of the dry expansion type. The catalog should be helpful to those concerned with air-conditioning, process, industrial, and commercial refrigeration applications.

In addition to describing the standard line of P-K coolers, the catalog contains such information as: charts and tables showing cooling surface required for capacities from 2 to 232 tons of refrigeration at water flow rates from 15 to 575 gpm and for various baffle spacings in single and two-circuit designs. A log mean temperature table; cooler selection data; dimensions; pressure drops; and typical piping arrangements are also included.

Turn-Style Table

The Pangborn Corp., Hagerstown, Md., announces a new four-page, two-color, illustrated, bulletin on its Rotoblast "Turn-style Table" for airless blast cleaning of castings. The bulletin tells and shows how the machine saves labor and dollars by cleaning in one section while the other section is being loaded.

The Rotoblast machine cleans by centrifugally throwing abrasive particles against the part being cleaned from the vanes of high-speed rotating "wheels."

Flexible Recorder

A precision-made autographic recorder which can be applied in any one of a wide variety of operations in the physical testing field, is described in Bulletin No. 330, recently issued by Baldwin-Lima-Hamilton Corp., Eddystone Div., Philadelphia, Pa.

This portable, self-contained recorder of the X-Y type is an invaluable aid in obtaining stress-strain records. It is usually employed in conjunction with a testing machine and extensometer equipment.

The Model MD-2 Recorder is readily convertible to numerous other applications which require the recording on rectangular co-ordinates of simultaneous relationship between any two variables that can actuate microformers.

Continued on Page 62

That *New-Type* ELDORADO Keeps Drawing Engineers!

More engineers than ever are using the great new-type ELDORADO

DRAFTSMAN: All *new-type* Eldorado H's are smooth, easy-going, and really hold their points! All—and I mean all.

ELDORADO: Right. You can't beat the *new-type* Eldorado with its stronger ...denser, more uniform lead and longer point life. Eldorado's exclusive *Leadfast* process insures no splintering or burring ...leads are truly centered. Rounded smooth edges of Eldorado's hexagonal shaft are easy to sharpen, comfortable to draw with.

DON'T WAIT... send for your free sample of the *new-type* Eldorado today ...the two degrees most useful to you.

Write on your business letterhead to the address below.

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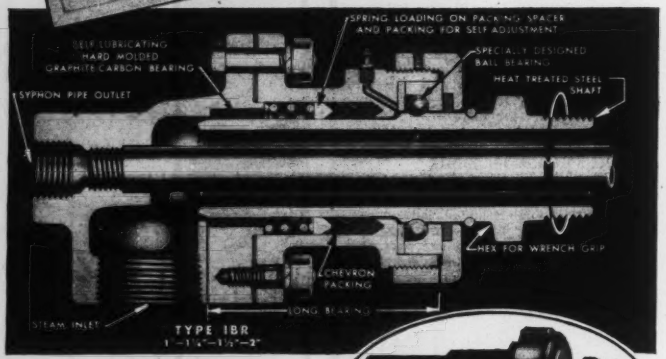

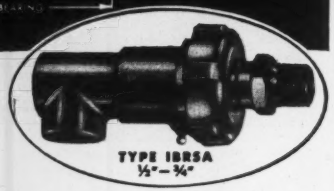

Syphon Style—TYPE IBR. Built for 450°F., steam service to 150 psi, and up to 500 RPM. Hydraulic service to 200 psi, 750 RPM. Higher pressure and speeds under certain conditions.

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HERE is the new *improved* Type IBR Barco Revolving Joint! Precision-built and field-tested, it has met with enthusiastic approval by machinery designers and operating engineers, alike. Here are some of the reasons why:

LOW TORQUE CUTS POWER COSTS! Wide spacing between bearings holds bearing loads to a low limit and maintains close alignment. Specially designed ball bearing carries both radial and end thrust. Inherent low torque is little affected by pressure, speed, or temperature. Up to 50% power savings.

COMPACT, SIMPLE, LEAKPROOF! Self-adjusting, self-sealing chevron type packing carried under light spring pressure provides a long life seal on specially hardened rotating sleeve, permits remarkably compact construction.

EASY SERVICING, LOW MAINTENANCE! Light running action minimizes wear, permits free-floating installation. No adjusting necessary. Internal parts are readily accessible—usually without removing joint from roll.

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• Keep Informed

Large Induction Motors

The large, polyphase induction motor, and where it fits into the industrial picture, is the subject of a new 28-page booklet, No. B-4739, available from the Westinghouse Electric Corp., Pittsburgh, Pa. Used extensively where a general-purpose drive is required, and where reliability and over-all costs are of prime importance, the induction motor embodies simple design and rugged construction.

The booklet presents a quick summary of the types and features of the two basic kinds of induction motors—Type CSF squirrel-cage motors for constant-speed drive, and Type CWF wound-rotor motors for adjustable-speed drive. Both types are available in a wide variety of open drip-proof and special enclosures, as illustrated in the booklet.

The unit-type stator and the all-metal rotor are discussed, and the bearing accessibility provided by split bearings and half brackets is illustrated, as is the copper-fin construction that has made possible important advances in motor enclosures.

Applications are illustrated for a number of industries.

Synchronous Generators

A new 32-page bulletin entitled "Hydraulic Turbine Driven Synchronous Generators and Large Vertical Motors" has been released by Allis-Chalmers Mfg. Co., Milwaukee, Wis.

The bulletin compares the suspended and umbrella types of vertical generators, describing construction standards and details of stator, rotor, bearing, and bearing housing construction. It shows the advantages of enclosed construction using air-to-water heat exchangers.

In addition to the vertical generators, the horizontal generator is described. Special modifications that can be incorporated into the design of hydraulic turbine generators are listed, along with accessories and tools.

Large vertical motors are quite similar in design and construction to vertical generators and are briefly described in the bulletin. Mention is also made of the combined motor-generator unit that can be used alternately as a hydraulic turbine-generator and as a motor-driven pump.

Fork Lift Trucks

A new 8-page descriptive bulletin released by Baker Industrial Truck Div., of the Baker-Raulang Co., Cleveland, Ohio, translates into user benefits the design and construction features of its FT fork trucks in 3000 and 4000-lb capacities.

Designed to give the reader complete information, this bulletin contains: (1) pictures and descriptions of major components of the trucks, (2) dimension drawings showing maneuverability, (3) detailed specifications, (4) pictures and descriptions of features that assure ease of handling and maintenance, (5) pictures of these trucks working in 8 different industries and 16 different applications, and (6) illustrations of 14 of the many attachments which can be applied to the trucks for the handling of material in sizes, shapes, and forms not practical with standard forks.

Pressure Sensitive Devices

Price List of SR-4 load and pressure-sensitive devices is announced by Baldwin-Lima-Hamilton Corp., Philadelphia, Pa. The bulletin gives domestic prices of 18 load cells of three types, 11 pressure cells, and 6 cantilever force beams

• Keep Informed

Pulp-Mill Drives

A new eight-page bulletin on electric motor drives for pulp mills now is available from the General Electric Co., Schenectady, N. Y.

The bulletin, No. GEA-5520, describes drives for barkers, saws, chippers, grinders, materials handling, washers, pumps, and allied pulp mill equipment.

The bulletin is illustrated with 18 photographs of G-E drives in operation in existing mills.

Flange and Coupling Selector

A revised edition of the popular Flange and Coupling Selector, designed by the Nooter Corp., St. Louis, Mo., is now available to all engineering personnel upon request.

In the same easy-to-read slide-rule form, it provides all the information contained in the earlier selector plus new and useful data.

The Flange Size Selector lists such relevant facts as the OD of flange, thickness, OD of raised face, number of holes, diameter of holes, diameter of bolts, bolt circle—for Series 15 and 30 flanges.

The Coupling Selector shows average sizes of standard, extra-heavy, 3000-lb and 6000-lb couplings. Also a convenient Pipe Standard Table is incorporated on the Selector, showing nominal wall thicknesses for schedules No. 10 to 160 as well as nominal thicknesses and weight per foot for standard, extra-heavy, and double-heavy pipe.

Technical Books

A special 1951 catalog listing Wiley technical publications in the field of mechanical engineering is now available to engineers.

Up-to-date information is included on books covering heating, ventilating, and air conditioning; internal-combustion engines; machine design; materials handling; production; pumps and compressed air; and thermodynamics and steam power. Copies are available from John Wiley & Sons, New York, N. Y.

New Solvent

Immunol, a liquid chemical, described in a booklet, has been developed by Haas Miller Corp., Philadelphia, Pa., which, when added to water, hot or cold, immunizes it against rusting ferrous metals. In addition it imparts unusual detergent properties and complete "wetting out" action. Immunol solutions are odorless and neutral, contain no soaps or alkalies, are noninflammable and will not affect the skin. Replaces alkali cleaners and inflammable solvents.

Coal-Handling Equipment

"Central Station Coal-Handling Equipment"—a new 20-page Bulletin No. 103—just issued—describes modern central station coal-handling practices as portrayed by recent installations; illustrates individual units of equipment; is complete with diagrams, dimensional drawings, etc. Profusely illustrated. Available from the C. O. Bartlett & Snow Co., Cleveland, Ohio.

Straddle Trucks

A catalog recently issued by Hyster Co., Portland, Ore., lists straddle trucks for mills, docks, warehouses, and industrial plants. Construction and performance data are presented. The Hyster M, MH, MHS straddle truck specifications are given. Accessories for the straddle trucks are also listed.

Continued on Page 64

For Drawings That Won't Get 'EDGY' With Age...

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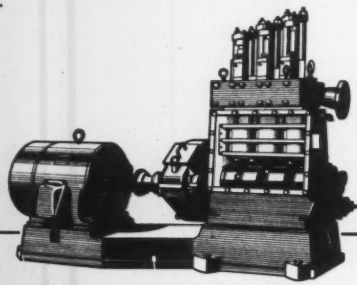
Famous for stamina and a sure foot, the burro was a hard-working "pardner" of the old-time prospector. He's a little fellow—but he packs more horse-power per pound than any of his four-footed cousins . . .

This ability to get more work done with fewer pounds to do it is precisely what Aldrich Direct Flow Pumps have to offer. As a result of improved design, weight of the fluid-end is considerably reduced. And—whereas a speed of 150 rpm was formerly considered high for reciprocating pumps—these compact, Direct Flow units are operating today at speeds of 500 rpm for the 3"; 360 rpm for the 5"; and 300 rpm for the 6" stroke. In each case, you get greater volume and higher pressure from a smaller pump: *you get more horse-power per pound.*

Applications where you'll find Aldrich Direct Flow Pumps putting in time and over-time include: hydraulic systems for press operation; plastic and rubber molding and extrusion; steel mill descaling, and other uses in the petroleum and chemical industries. Write today for Data Sheets 64, 64B.



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. . . Originators of the Direct Flow Pump

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Seattle • Spokane, Wash. • Syracuse • Tulsa • Export Dept.: 751 Drexel Building, Phila. 6, Pa.

• Keep Informed

Maxitorq Clutches

The Carlyle Johnson Machine Co., Manchester, Conn., offers a new Case History Book showing original equipment installations of their Maxitorq floating disk clutches.

Industrial products represented include an ore loader, can-seaming machine, packaging equipment, power sweeper, industrial truck, machine tools (milling, chucking, multiple automatic tapping, automatic lathes, shaping, honing) and lumbering machinery—all products of nationally known manufacturers.

This book is fully illustrated and includes complete information on the Maxitorq clutch, as well as the new Maxitorq automatic overload release clutch—especially designed for protection of high-speed machinery such as packaging, labeling, and wrapping machines.

Integral One-Piece Fintubes

"Integral One-Piece Fintubes"—a new 8-page Bulletin No. 511 describes the construction of these integral extended surface fintubes; lists the range of sizes and the materials in which they are available; illustrates the wide variety of heating and cooling applications in which they are used, and gives three pages of extremely helpful engineering data, including design curves and a tabulation showing the comparative outside surface areas provided by different sizes of bare pipe or tubing, and longitudinally finned pipe or tubing. Available from the Brown Fintube Co., Elyria, Ohio.

Loading Resistors

A new eight-page illustrated bulletin, No. GEA-5515, on loading resistors for testing Diesel-electric locomotive power plants is now available from the General Electric Co., Schenectady, N. Y.

The bulletin outlines all the advantages of the loading resistor, its uses, ratings and dimensions, and operating instructions. A complete description of the power connections, loading characteristics, instruments, blower unit, resistors, and switches follows.

A list of railroads and other companies using the loading resistors is also included.

Properties and Working of Stainless Croloy Tubes and Pipe

A complete handbook, "The Properties and Methods of Working Seamless and Welded Tubes and Pipe of the B & W Stainless Croloys," is offered by the Babcock & Wilcox Tube Co., Beaver Falls, Pa. Intended for engineers, designers, and fabricators, it is designed to serve as a guide in choosing the proper material and as a help in planning the conversion of stainless-steel tubing into finished products for industry. The 104-page leather-bound booklet is 8 × 5 in., a handy size for desk or pocket.

It describes B & W Stainless Croloy Tubing Steels and deals with methods of manufacture and inspection, corrosion and oxidation resistance, and methods of working and fabrication, all illustrated with photographs, detailed diagrams, and useful charts. Tables of technical data for eight different types of stainless Croloys, covering physical and mechanical properties and processing data, are given, along with an interesting list of applications ranging from aircraft exhaust assemblies and dental instruments to pump cylinders and valve seats. The booklet also includes temperature and linear conversion tables.

• Keep Informed . . .

Hydrogen Zeolite Water Softeners

Cochrane Corp., Philadelphia, Pa., manufacturers of water-conditioning equipment and steam specialties have just issued a new publication (No. 4530) on Cochrane Hydrogen Zeolite (Cation Exchange) Softeners. This 16-page bulletin gives a complete description of the process and the field of application, showing the advantage of hydrogen zeolite softening and its relation to the sodium zeolite softening process.

Multistage Compressors

A new catalog on centrifugal multistage compressors, has been issued by Clark Bros. Co., Inc., Olean, N. Y. In addition to being a complete descriptive piece on Clark units, the engineering section places at the disposal of prospective customers complete engineering data to allow an engineer to approximate the power requirements, rotative speed, and discharge temperature for most multistage centrifugal compressor applications.

Adjustable-Speed Calender Drives

A new eight-page bulletin, No. GEA-5588, on adjustable-speed calender drives now is available from the General Electric Co., Schenectady, N. Y. The bulletin deals with G-E drives for calendering rubber, plastics, and similar materials. Illustrated by nineteen photographs and a series of charts and diagrams, it outlines the uses and advantages of the electronically regulated drives. The bulletin includes dimensions and horsepower ratings of all G-E calender drive motors and motor-generator sets.

Long-Nose Oil Burners

A new catalog, No. 412, issued by Hauck Mfg. Co., Brooklyn, N. Y., describes long-nose-type low-pressure air-atomizing oil burners. They are especially suitable for applications where the burner nozzle must extend into the furnace for some distance so that the flame will start farther away from the firing wall.

Roller Chains and Sprockets

A new catalog, RS-50, covering a full line of roller chains and sprockets from stock has been released by the Whitney Chain Co., Hartford, Conn. The catalog provides complete specifications and engineering reference tables on American standard roller chains, sprockets, and attachments. Dimensional data, strengths, and weights are also supplied on allied products, such as block chain, cable chain, and flexible couplings.

Power Operated Lubricated Plug Valves

Piping, wiring, mounting, and installation data for power-operated Nordstrom lubricated plug valves has been issued in a new manual by the Rockwell-Mfg. Co., Pittsburgh, Pa. This bulletin is the first complete compilation of technical data covering the use of pneumatic, hydraulic, and electric operators for lubricated plug valves. Included are typical piping diagrams, arrangements for both side and top-mounted motor controls, closing speeds, wiring data, and an extensive group of photos of actual installations.

Materials-Handling Equipment

A comprehensive catalog of materials-handling equipment has been released by the Yale & Towne Mfg. Co. Philadelphia Div., Philadelphia, Pa. Subjects covered include a general description and application data on Yale's gas and electric fork-lift trucks, motorized hand trucks, hand lift trucks, and hand and electric hoists.

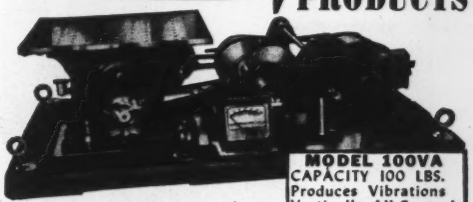
Included are descriptions of the various attachments available for Yale industrial trucks that give them versatility in jobs performed.

Air Conditioning

The equipment needed to do a job of air conditioning: Cooling, heating, dehumidifying, cleaning, filtering, circulating; or ventilating; or air handling is covered in a 16-page condensed catalog available from Westinghouse Electric Corp., Sturtevant Div., Boston, Mass. The equipment listed has been carefully selected from the full line.

Covered in the catalog are: hermetically sealed compressors, condensers, water coolers, heating coils, cooling coils, air-handling units, heating and ventilating units, surface dehumidifiers, air washers, filter washers, central-plant type completely self-contained air-conditioning units, "within-the-space" type self-contained air-conditioning units, unit heaters, industrial heaters, centrifugal fans, axiflo pressure fans, v-belt ventilating sets, direct-connected ventilating sets, industrial fans, centrifugal compressors, induced-draft fans, forced-draft fans, and inlet-vane control assemblies.

VIBRATION Fatigue Tests POINT THE WAY TO IMPROVED PRODUCTS



MODEL 100VA
CAPACITY 100 LBS.
Produces Vibrations Vertically. All Controls In Easy Reach.

You can be sure if your products pass a vibration fatigue test—substantiates design and construction materials—frequently exposes excessive material. Many things can be learned from tests. A "must" for electronic, aircraft and automotive parts and assemblies. Hundreds in use. Models to handle parts from 10 lbs. to 100 lbs.—choice of vertical or horizontal table movement. Frequencies of 600 to 3,600 v.p.m. Special machines to order. Catalog F contains treatise.

Made by makers of ALL AMERICAN PRECISION DIE FILING MACHINES

ALL AMERICAN Tool & Manufacturing Co.

1016 Fullerton Ave., Chicago 14, Ill.

THIS CATALOG

in your hands..

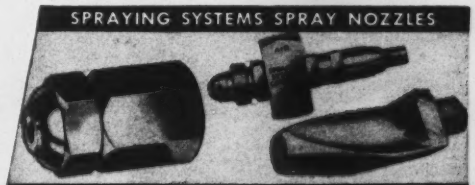
can be a good first step toward improving spraying operations in your plant. See for yourself how Spraying Systems' specialized experience in spray nozzle design and manufacture can work for you.

Get the EXACT spray nozzle type and size to fit your need.

WRITE for Catalog 22 . . . General Catalog
Catalog 23 . . . Pneumatic Atomizing Nozzle Catalog

SPRAYING SYSTEMS CO.
3265 Randolph Street • Bellwood, Illinois

SPRAYING SYSTEMS SPRAY NOZZLES



the SPECIFIED nozzles for industrial use

THROUGHOUT NEARLY A HALF CENTURY

Powerful Goodman Machines Have Been Equipped With DIAMOND ◆ Roller Chains

• Pioneer builder of rugged, fast production mining machinery, Goodman has had nearly a half century experience with Diamond Roller Chain Drives.

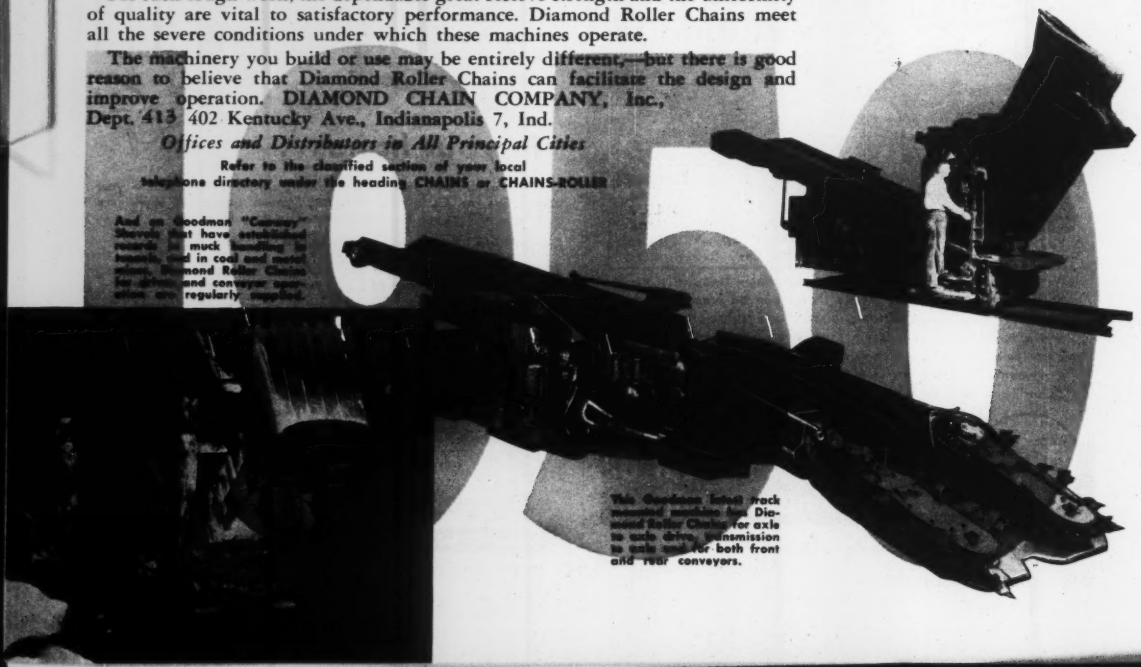
For such tough work, the dependable great reserve strength and the uniformity of quality are vital to satisfactory performance. Diamond Roller Chains meet all the severe conditions under which these machines operate.

The machinery you build or use may be entirely different,—but there is good reason to believe that Diamond Roller Chains can facilitate the design and improve operation. DIAMOND CHAIN COMPANY, Inc., Dept. 413 402 Kentucky Ave., Indianapolis 7, Ind.

Offices and Distributors in All Principal Cities

Refer to the classified section of your local telephone directory under the heading CHAINS or CHAINS-ROLLER

And on Goodman "Conveyo" Shovels that have established records for muck handling in tunnels, and in coal and metal mines, Diamond Roller Chains for drives and conveyor operation are regularly supplied.



This Goodman latest track mounted machine has Diamond Roller Chains for axle to axle drive, transmission to axle and for both front and rear conveyors.

Efficient Exhaust and No Space Wasted

"Buffalo" VANEAXIALS MOUNTED IN VERTICAL EXHAUSTS

ROOF INSULATION OF PAPER COMPANY POINTS WAY TO SAVINGS IN MANY INDUSTRIES

Above are part of the ten 36″ "Buffalo" Type "B" Vaneaxial Fans mounted in roof exhausts of West Virginia Pulp and Paper Co., Mechanicville, N. Y. Note how the fans fit in like a section of pipe. Their light weight obviates heavy, expensive mountings, and the fans waste no space. The steam comes from hoods from Nos. 5 and 6 paper machines—and passes straight through the pipes and fans with absolute minimum resistance. (At right, note how motor is entirely removed from air stream.) Whenever YOU need fans for mounting in straight duct runs, you'll save money with "Buffalo" Vaneaxials!

YOURS! This helpful Bulletin No. 3533-C! Describes "Buffalo" Axial Flow Fans and their uses. Write for your copy!

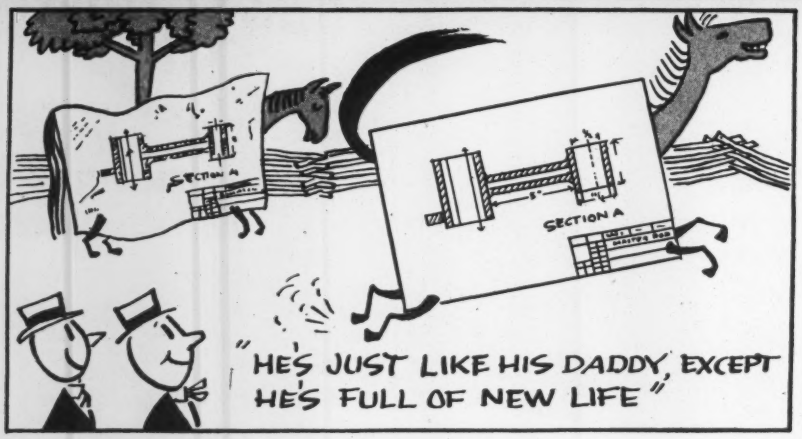
"Buffalo" FIRST FOR FANS

BUFFALO FORGE COMPANY

148 MORTIMER ST. BUFFALO, N. Y.

Canadian Blower & Forge Co., Ltd., Kitchener, Ont. Branch offices in all Principal Cities

VENTILATING FORCED DRAFT | AIR WASHING COOLING | AIR TEMPERING HEATING | INDUCED DRAFT EXHAUSTING PRESSURE BLOWING



PHOTACT* makes 'em young again

A fresh start—that's what you get with K&E PHOTACT* materials. Even if your original tracing is old, soiled, tattered and torn—too far gone to make half-way readable reproductions—you can have a new tracing without having to draw it all over again.

From your battered original you can have a PHOTACT "second original," more vigorous, keener than its daddy ever was, even the day he was born.

You never saw a job of rejuvenation like a PHOTACT "second original" on tracing paper or tracing cloth. Weak, blurred lines are turned into solid, opaque ink-like black lines. Fingermarked, smeared, messy backgrounds become clean, clear and white.

Your new tracing is young and peppy, and good for all the working prints you want to make from it, by whatever process you prefer!

PHOTACT "second originals" can serve you other ways, too. For instance, they save the time and expense of ink tracings, when you have to furnish them to the government or to contractors. PHOTACT "second originals" are accepted . . . they are every bit as good.

K&E offers a booklet on PHOTACT materials that may give you some useful ideas. It explains the simple process. Ask your nearest K&E Distributor or Branch, or write to the main office at Hoboken.

*Trade Mark

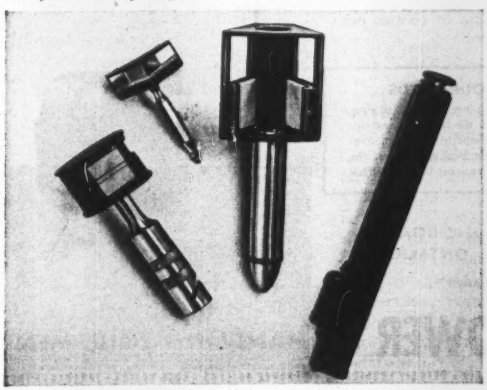
It's hard to get a right angle, these days.

In today's cockeyed world it takes more than a pocket-size gadget to give you the right angle on things. Or does it?

No, by Euclid, that's exactly what a K&E Right Angle Prism or a K&E Right Angle Mirror will do. And it will fit in your pocket, besides.

These versatile little fellers will do plenty for you. They'll measure plusses of things that aren't on the survey line. They'll measure offsets and save you "swinging" tape. They'll take cross sections, help you stake out small structures, lay out squares for contouring and do a whole lot of surveying jobs as well. They'll even give you a hand in laying out circular curves.

They are a family of four. You can take your choice and you may want to ask your nearest K&E Distributor or Branch for the K&E Booklet "Right Angles with Pocket Instruments". Or just write to Keuffel & Esser Co., Hoboken, N. J.



There's a laugh in many a graph

Graphs have been kidded, but the fact remains that graphs know their business, and that business knows its graphs.

Keuffel & Esser make over 300 kinds of graph sheets and co-ordinate papers and cloths. They are for three main purposes:

1. for plotting engineering or scientific "dissa and data"—square or rectangular section, logarithmic, reciprocal, electrical and so forth.
2. as guides for sketching or drawing—mechanical, architectural, surveying or mapping.
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They come in continuous rolls, in sheets and in pads, in various grades of paper (including famous ALBANENE*), and cloth. Somebody could write a book on *K&E Graph Sheets*, and somebody has. Get a copy! It describes K&E's 300 types.

*Trade Mark ®

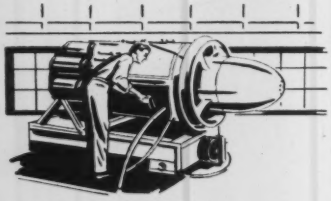
K&E
partners in creating
For 83 years K&E equipment and materials have been partners of the draftsman, engineer and scientist in shaping the modern world.

American Blower . . . a time-honored name in air handling

Syracuse, N.Y., too, has a conveniently located American Blower Branch Office to provide you with data and equipment for air handling. You can reach American Blower in Syracuse by calling 3-7058. In other cities, consult your phone book.

DANDY CANDY . . .

Some mighty tasty Swiss chocolates are made near Syracuse. And we're proud that American Blower HS Fans contribute toward their creamy goodness. In the making of fine candies, as with many other manufacturing processes, precise control of temperature and humidity is vital. American Blower HS Fans are an important part of this and other air conditioning jobs. Their non-overloading power characteristics and remarkable efficiency over a wide range save money.



DEFENSE SENSE . . .

Why not call on American Blower to help work out the air handling assignments in your new defense plant? We've plenty of valuable firsthand experience. For example, an important new aircraft engine plant will shortly be using a large quantity of American Blower Sirocco and Vaneaxial Fans. Good ventilation is good business in your plants, too.

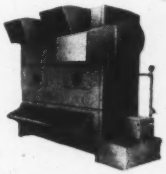
FAN PLAN . . .

If you haven't yet checked the advantages of using an American Blower Attic Fan in your business or home, do so. It's the lowest cost method of comfort cooling we know. No costly building alterations, no refrigerating machinery is used. All American Blower Attic Fans carry Certified Ratings; cost just a few cents a day to operate. Ask your electrical supply house or contact our nearest branch office.

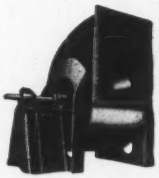
WHATEVER YOUR NEEDS . . .
American Blower heating, cooling, drying, air conditioning and air handling equipment can do much toward improving comfort and efficiency in business. For data, phone or write our nearest branch office.

Unit Heaters

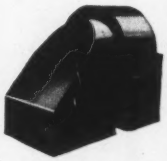
Ventura Fans



Air Conditioning Equipment



Industrial Fans

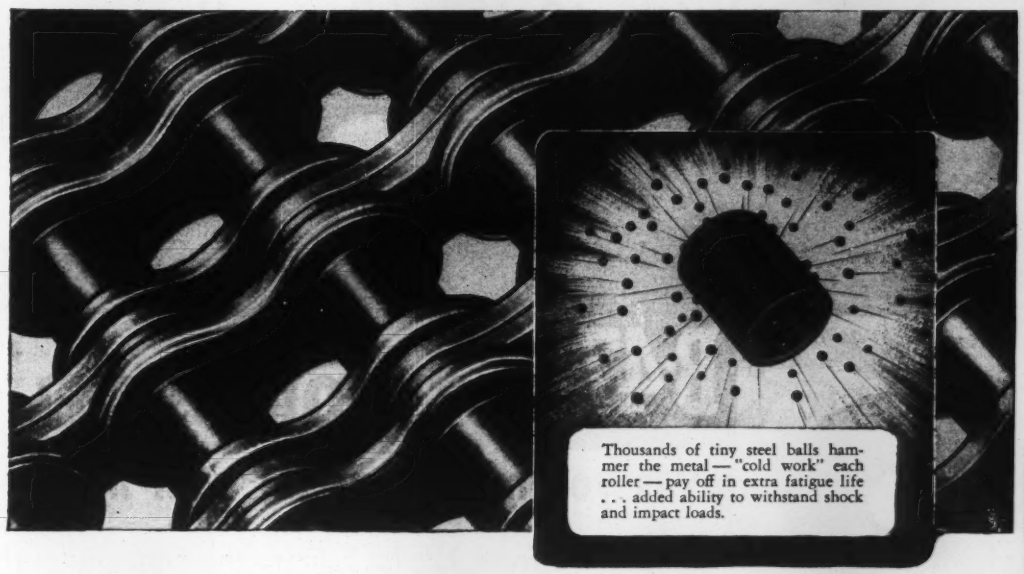


Utility Sets

AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO
Division of American Radiator & Standard Sanitary corporation

YOUR BEST BUY AMERICAN BLOWER AIR HANDLING EQUIPMENT

Serving home and industry: AMERICAN-STANDARD • AMERICAN BLOWER • CHURCH SEATS • DETROIT LUBRICATOR • KEWANEE BOILERS • ROSS HEATER • TONAWANDA IRON



Thousands of tiny steel balls hammer the metal — "cold work" each roller — pay off in extra fatigue life . . . added ability to withstand shock and impact loads.

Why you should be sure the roller chain you buy has

SHOT-PEENED ROLLERS

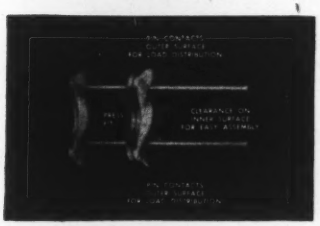
. . . one of the extra-strength features you get with every LINK-BELT Roller Chain

Look for the distinguishing darkened rollers on every roller chain you buy! They're your guarantee of extra fatigue life.

Shot-peening is just one of the added manufacturing refinements that make Link-Belt Precision Steel Roller Chain a longer-life chain. Controlled material selection and heat treating assure absolute uniformity . . . no weak members.

Link-Belt Roller Chain is available in single or multiple widths, in ⅜ to 3 in. single and double pitch. For the best in roller chain, get in touch with your nearest Link-Belt office.

Easier coupling and uncoupling without sacrificing load distribution

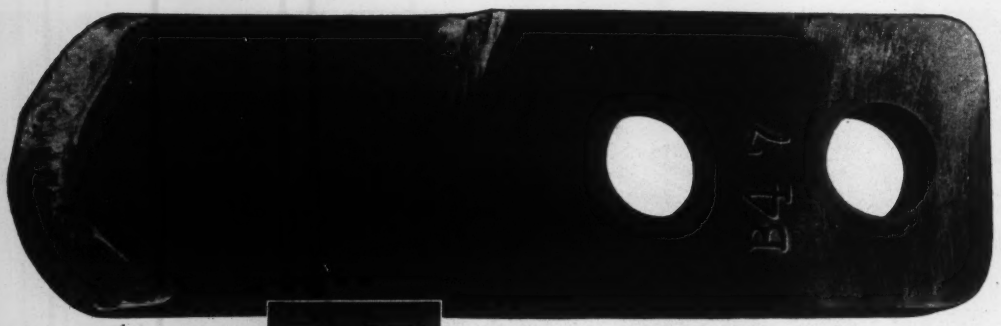


Patented E-Z Assembly feature of Link-Belt Precision Steel Roller Chain has won world-wide approval. Coupling and uncoupling of multiple width chains—right on the job—is far easier. There's absolutely no sacrifice of load distribution . . . no loss of the chain's remarkable performance. Press-fits between chain pins and middle bars have been modified. But full load-carrying capacity across the entire width of the chain has been maintained.

LINK-BELT

PRECISION STEEL ROLLER CHAIN

LINK-BELT COMPANY: Indianapolis 6, Chicago 9, Philadelphia 40, Atlanta, Houston 1, Minneapolis 5, San Francisco 24, Los Angeles 33, Seattle 4, Toronto 8, Springs (South Africa). Offices, Factory Branch Stores and Distributors in principal cities. 12.333



This punch gave double service!

This block had double life!

This die lasted 50% longer!

B-47 HOT WORK STEEL

gives you more runs for your money

. . . anywhere from 1½ to 5 times the Performance!

SOME TYPICAL EXAMPLES

B-47 dummy blocks, vs. 9% and 12% tungsten types, extruded more than twice as many brass and copper tubes. B-47 dies outperformed 12% tungsten type 1½ to 1.

B-47 punches, vs. low-carbon 18-4-1 type, hot pierced more than twice as many eyes in steel axes. See top picture.

B-47 die inserts, vs. 9% tungsten types, hot pressed more than twice as many steel side gear forgings. B-47 die inserts, vs. regular insert material, performed better than 5 to 1.

B-47 dummy blocks, vs. 5% tungsten-5% chromium types, extruded twice as many copper and brass tubes and rods. B-47 dies outperformed 12% tungsten-12% chromium type.

B-47 punches, vs. 5% chromium type, hot extrusion forged 1½ times as many automotive steel front axle spindles.

B-47 die inserts, vs. 9% tungsten types, extruded 1½ times as many high alloy steel automotive valves. This is considered a very difficult job for any grade of hot work steel.

SEND NOW

for "Blue Sheet" on Grade B-47

This four-page folder gives technical data on B-47 for brass extrusion dummy block and dies, valve extrusion die inserts, hot punch tools, forging die inserts, press forging dies, and hot work in general. *Write for your copy today.*

ADDRESS DEPT. ME-18

Looking for a better hot work steel? You'll find it in B-47—an improved chromium, tungsten, cobalt, vanadium type whose superiority is established by actual performance runs such as those summarized above. All tests show that B-47 has unusual resistance to shock and abrasion at elevated temperatures.

Developed originally for applications in the copper and brass industry, B-47 has given excellent results on difficult hot work jobs on steel. B-47, when properly heat treated, exhibits a well rounded combination of red hardness, toughness, and resistance to wear and heat checking that makes it a valuable addition to the Allegheny Ludlum group of hot die steels.

Put B-47 to the test. You'll find that it will do any number of severe hot work jobs without washing out or changing size. Get in touch with A-L, today. Let us help you to use B-47.

● *Allegheny Ludlum Steel Corporation, Henry W. Oliver Bldg., Pittsburgh 22, Pa.*

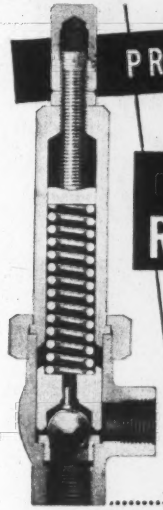
For complete MODERN Tooling, call

Allegheny Ludlum

AL FINE TOOL STEELS SINCE 1854

WAD 3530

Specify these Edward Steel Valves . . . from the Line that Gives You the Better Designs



PROTECT EQUIPMENT

against abnormal pressure increases with

Edward RELIEF VALVES

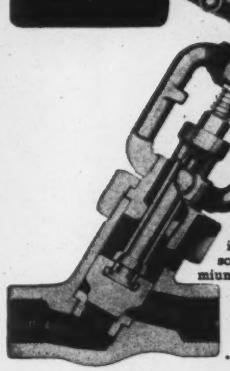
Edward relief valves protect equipment against sudden and unusual pressure increases in piping systems. Foolproof design and accurate spring action make them absolutely dependable. One low cost valve can save much expensive equipment.

Used extensively in power, chemical, process, petroleum, hydraulic, marine, and general industrial service, they are particularly suited for relieving pressure in pump lines, drums, heat exchangers, and unfired pressure vessels handling water, steam, oil, or vapor.

They need no packing, maintenance is negligible, and the fine pitch threads of the adjusting screw allow close regulation of pressure setting.

NEW BULLETIN Write for new free bulletin No. 711 containing latest design details, dimensions, weights, and installation information.

Edward PRESENTS New ALL-PURPOSE STEEL VALVES



A new all-purpose valve series, ideal for almost any service where small O. S. & Y. steel valves are used.

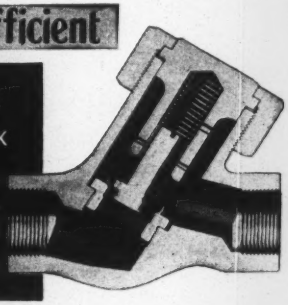
Drop forged steel for greatest strength . . . simplest packing arrangement . . . tight, easily accessible union or bolted bonnet joints . . . bronze yoke bushings . . . microscopically mated seats and disks . . . lock welded parts. Built in sizes ¼ to 2 in. inclusive, globe or angle, screwed or socket welding ends, carbon or chromium molybdenum steels, in 600 or 1500 lb sp classes. Stocks now available.

Bolted bonnet 1-¼ in. up 600 lb, 1 in. up 1500 lb. Union bonnet in smaller sizes.

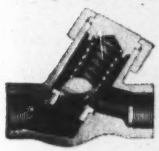
For full details, dimensions, illustrations write today for your free copy of . . . . **BULLETIN 501**

Quiet . . . Efficient

Edward NON-SHOCK Ball & Piston CHECK VALVES



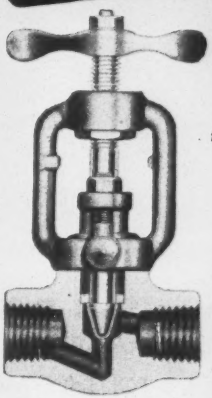
Vibration, clatter, and damaging shock to piping are cut to a minimum with Edward forged steel ball and piston check valves. Cushioned closing action eliminates excessive vibration. Accurate guiding and spring loaded construction assure fast positive seating.



EValloy stainless steel seat and ball or piston give maximum trouble-free service.

Union or bolted bonnet in sizes ¼ in. to 2 in. inclusive in two pressure classes —600 lb at 850 F and 1500 lb at 850 F. For complete information, write for Catalog 104.

PRECISION REGULATION Edward Instrument Valves



New Edward Fig. 952 series instrument valves, so compact they fit limited spaces in such hook-ups as panel boards and manifolds, give precision regulation for meter, gage, regulator, by-pass and instrument lines of all types. Forged steel, globe or angle. Rated 6000 lb WOG, 1500 lb 850 F in carbon steel. Also in stainless steels with higher ratings.

- **No bonnet joint to leak.**
- **Swing bolted gland for easy packing.**
- **Needle point stem, fine pitch threads for accurate regulation.**

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Edward Valves, Inc.

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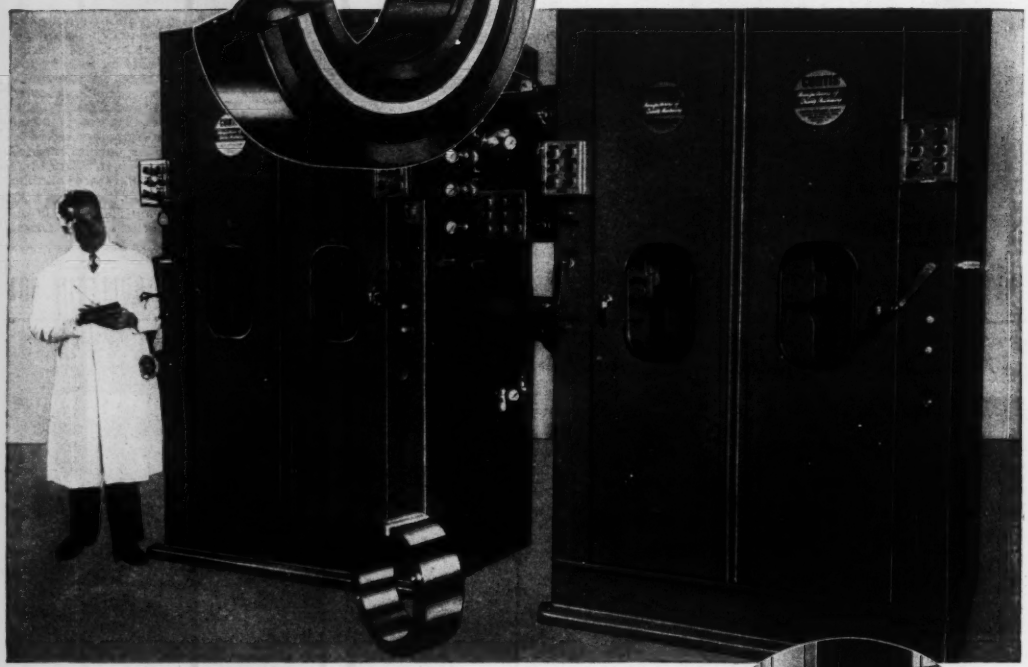
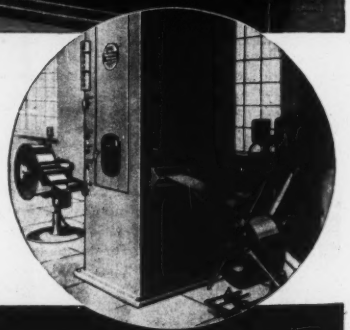
M-R-C

Synthe-Seal Ball Bearings



CURTIS STRAIGHT-O-MATIC in a leading New England Steel Mill



50 M-R-C Synthe-Seal Ball Bearings
used in the CURTIS 600AA STRAIGHT-O-MATIC
METAL STRIP GRINDER & POLISHER *(either wet or dry operation)*, equipped with synthetic rubber seals — provide positive protection against grit and moisture, assuring smooth trouble-free operation and low maintenance cost.

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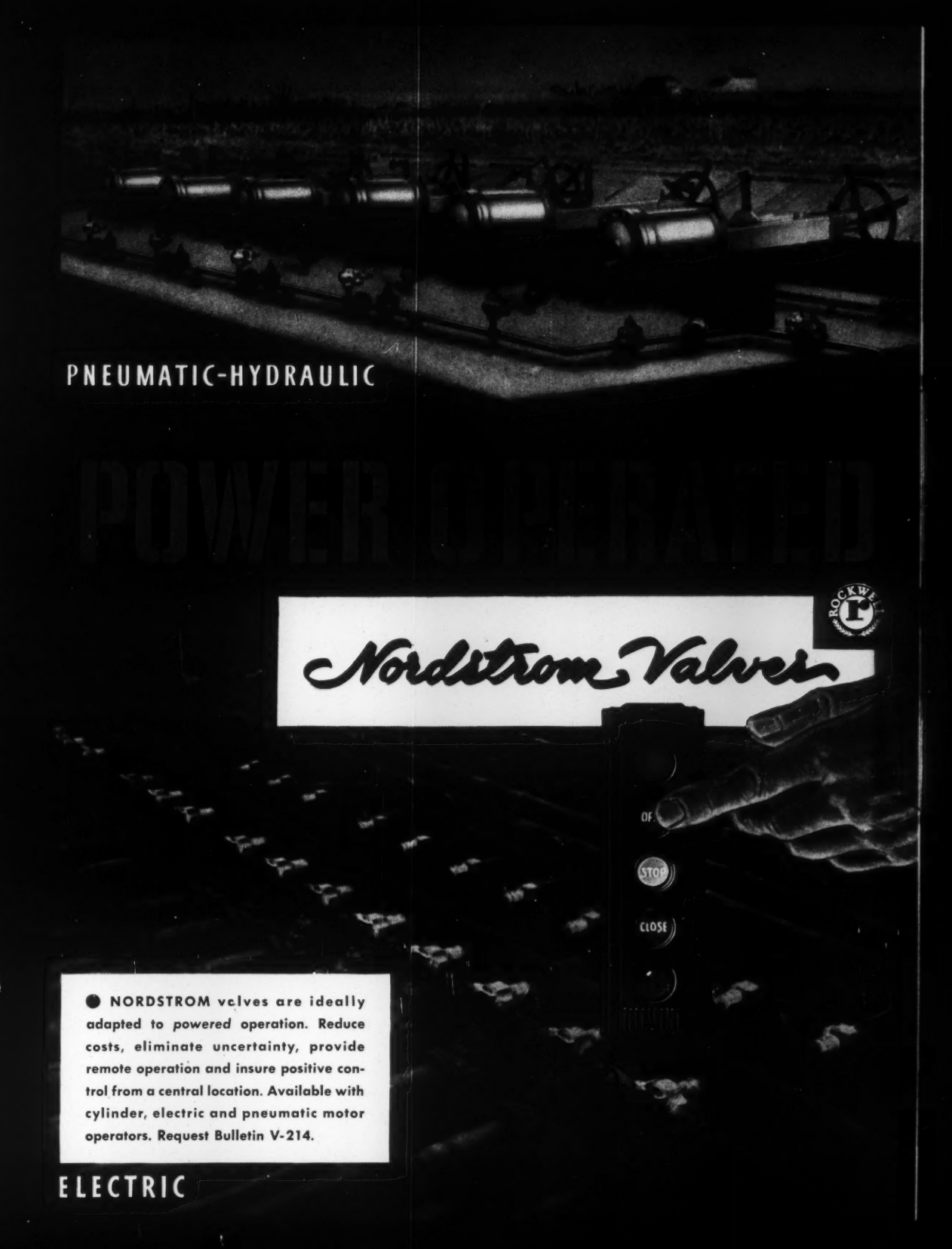
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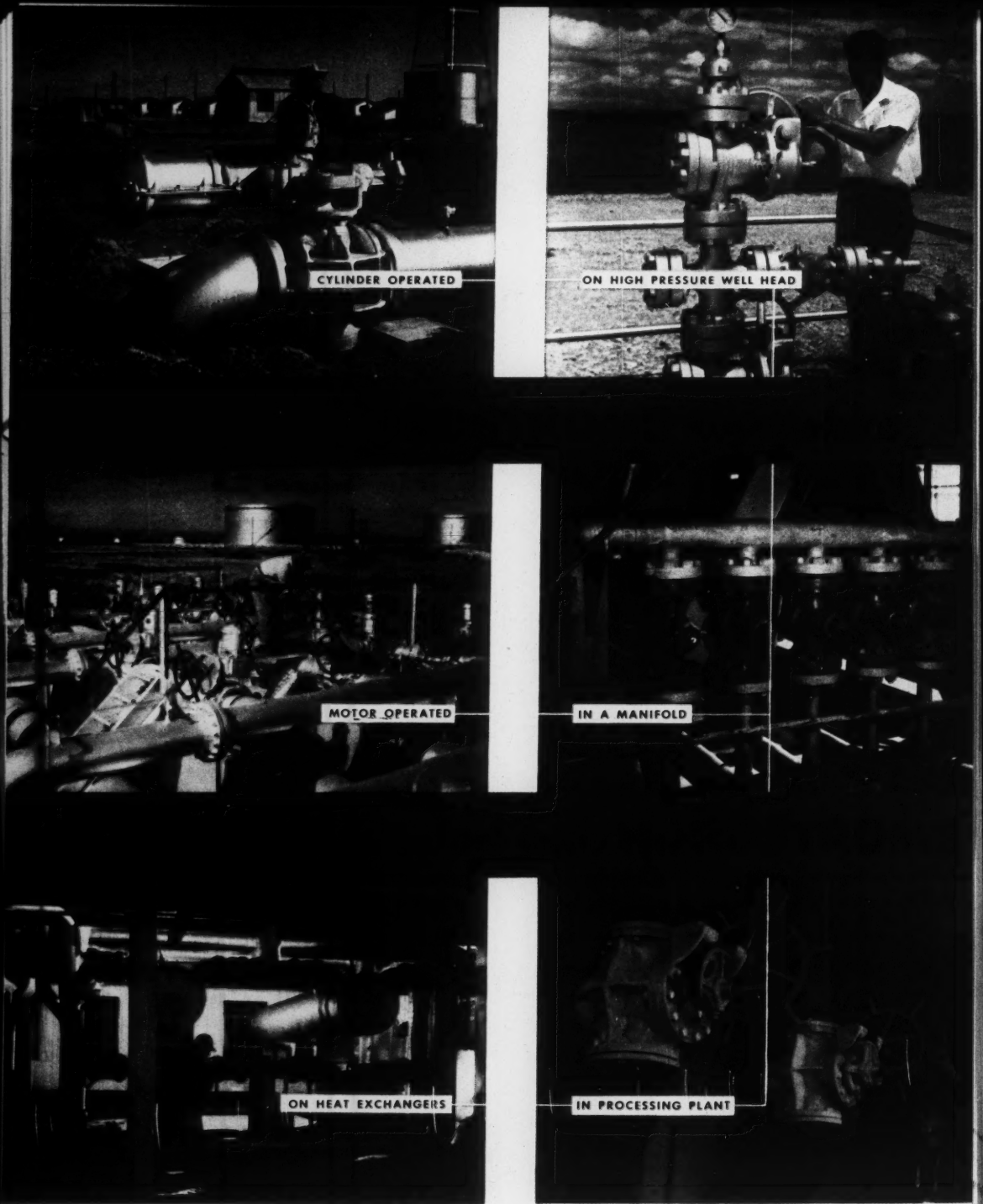

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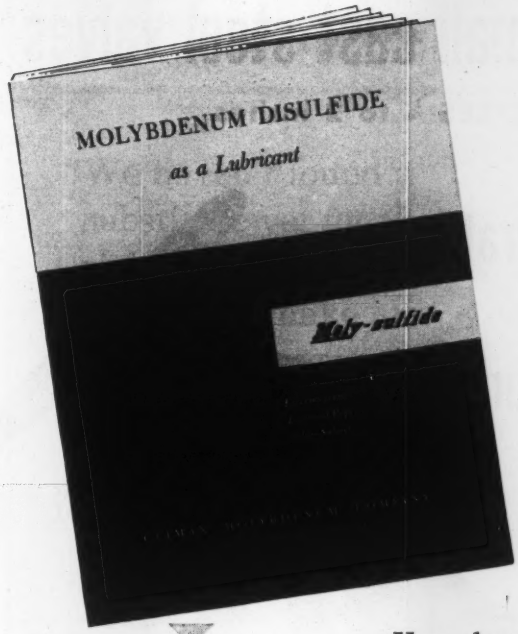
Atlanta, Boston, Chicago, Columbus, Houston, Kansas City, Los Angeles, New York, Pittsburgh, San Francisco, Seattle, Tulsa ; . . and leading Supply Houses. Export: International Division, Rockwell Manufacturing Company, 7701 Empire State Building, New York 1, N. Y.



What do you know about MoS_2* as a lubricant?

* Molybdenum disulfide

You have probably heard reports, some enthusiastic, some conservative, of the remarkable properties of Molybdenum Disulfide as a new lubricant.

For those who wish to review published information on this subject, we have compiled a 55 page publication containing excerpts from authoritative technical papers. Copies are free—write now.

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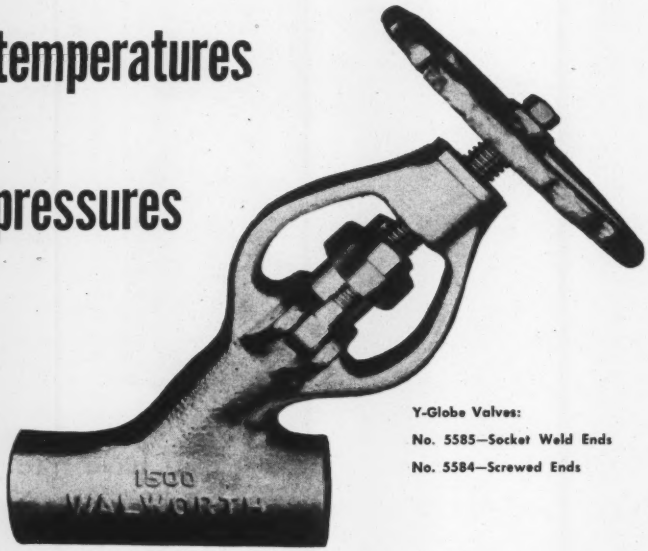
MS1

Walworth's NEW small cast steel valves

SERIES 1500 — SIZES ¼ to 2 inches

handle HIGH temperatures
HIGH pressures



Y-Globe Valves:
No. 5585—Socket Weld Ends
No. 5584—Screwed Ends

Walworth is proud to make these new Small Cast Steel Valves available to power stations . . . oil refineries . . . ships . . . wherever piping is subject to severe pressures and temperatures. Non-shock service ratings of these valves: 1500 psi—950F for steam; 3600 psi—100F for water, oil or gas. Cast of chromium molybdenum steel, they are compact and light, yet exceptionally strong. Both Y-Globe and Angle type valves are available.

Angle Valves:
No. 5587—
Socket Weld End
No. 5586—
Screwed End

Simplified Walworth design eliminates many of the valve problems encountered in high pressure service. Among the features of this new valve are:

INTEGRAL BODY AND YOKE — made from a single casting without threading or welding. Bonnet joint — always a potential source of leakage — is eliminated. Valves can be reassembled quickly and easily.

ROTATING DISC — prevents valve seat distortion and consequent leakage. Cuts down replacements.

WELDED SEAT RING — compensates for changes in pressure and temperature—eliminates a major source of leakage.

SPECIAL BACK SEAT BUSHING — permits repacking the valve under pressure with greater safety.

PACKING CHAMBER — designed to dissipate heat thus keeping packing rings at lower temperatures—gives them longer life.

These valves are available with either socket weld ends or screwed ends, in sizes ranging from ¼ to 2 inches. For further information on Walworth series 1500 Small Cast Steel Valves, see your local Walworth distributor, or write for Circular No. 134.

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valves • fittings • pipe wrenches

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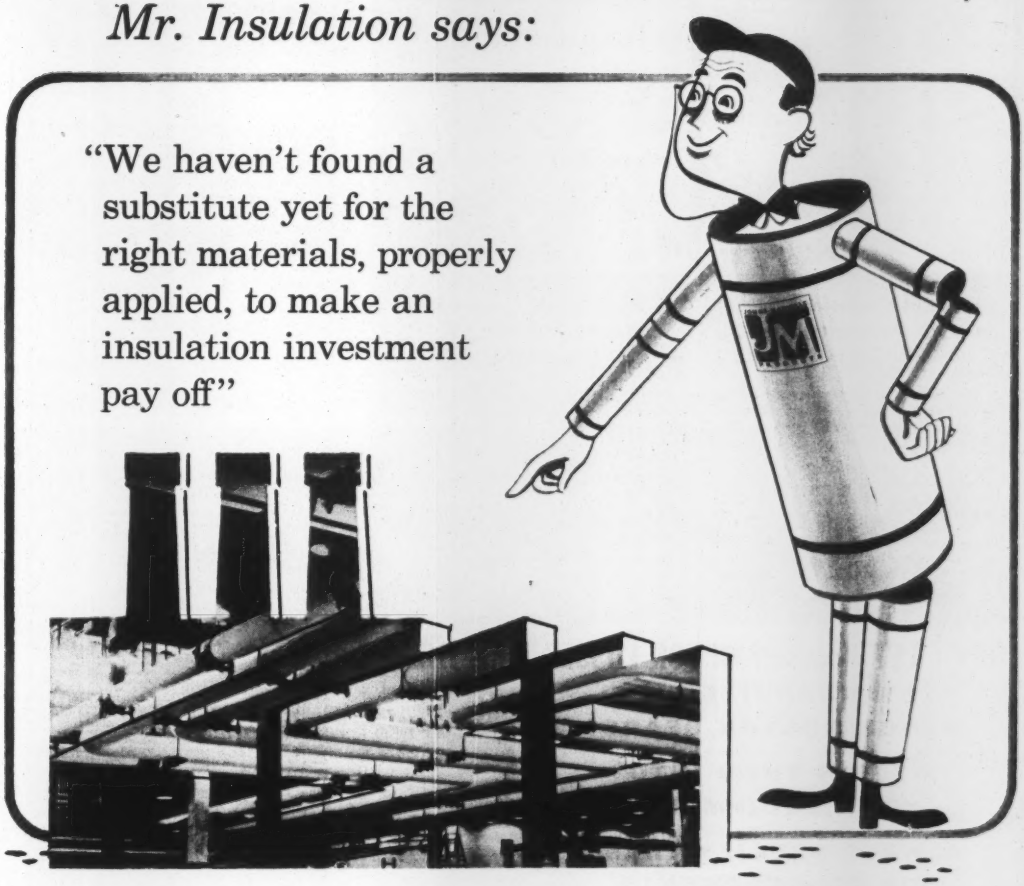
"We haven't found a substitute yet for the right materials, properly applied, to make an insulation investment pay off"



To be successful an insulation job must be properly engineered. In addition, it must have these two important ingredients:

1... THE RIGHT MATERIALS: service conditions vary greatly in industrial applications. That's why no one insulation can serve as a jack-of-all-trades on all jobs. For this reason, Johns-Manville uses asbestos and many other selected raw materials to produce the most complete line of insulations available. These insulations serve applications ranging between the extreme temperatures of 400F below zero to 3000F above.

2... THE RIGHT APPLICATION: Here again Johns-Manville's long experience in the field of insulation can be of value to you. Insulation engineering advice plus the services of insulation contractors trained in Johns-Manville methods of correct application are at your call.

If you are planning an insulation job why not put your problem up to insulation headquarters? Write Johns-Manville, Box 290, New York 16, N. Y.

JM

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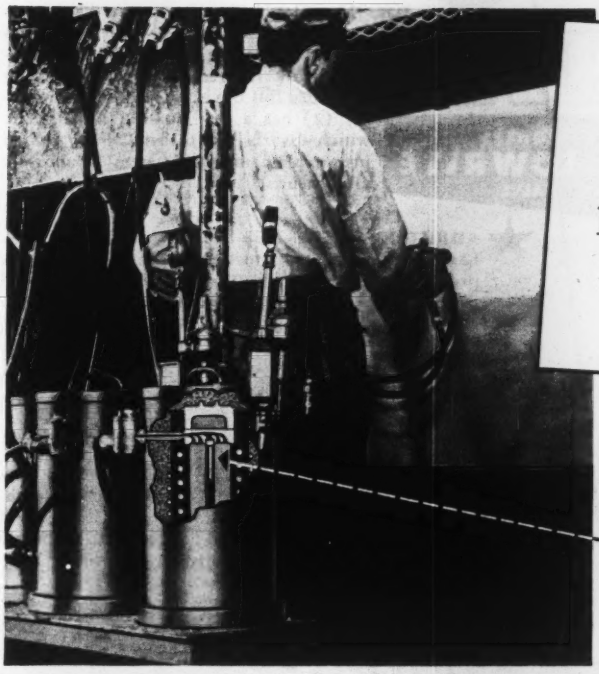
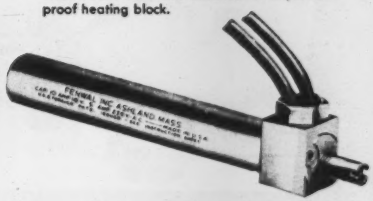


Multi-Purpose Thermostat helps solve heat-control problem in Bede Paint Heater

BEDE PAINT HEATERS, used to speed up paint spraying and save material by heating both paint and air, rely on Fenwal Block Head THERMOSWITCH Unit installed in explosion-proof heating block.



When Bede Products, Inc. originally designed the Bede Paint Heater it faced a primary problem: safety.

Underwriters' Laboratories, Inc. cautioned against the danger of electrical heating in paint spraying areas. So a metal block with pipes for paint and air was made explosion-proof by a special surface cover and fittings. The temperature control unit, which had to be compact, economical and accurate, could then be located in the block, flanked by heating elements.

LOW-COST SOLUTION

A Fenwal THERMOSWITCH Unit — 8/10 of an inch in diameter — met all specifications: low cost, precise performance, compact size, high current-carrying capacity. By this, it enables Bede Paint Heaters to lower the cost of paint spraying throughout industry.

YOUR PROBLEM?

Many types of control problems can be solved by easy-to-install, easy-to-maintain Fenwal THERMOSWITCH thermostats. Their activating control element is the single-metal shell that expands or contracts *instantaneously* with temperature changes, making or breaking the totally enclosed electrical contacts. Through this unique principle, THERMOSWITCH Units effectively control *many* variables where heat is a factor.

Find out now how Fenwal THERMOSWITCH Units can help you in *your* product. Mail coupon today.

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TEMPERATURE CONTROL ENGINEERS

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- ☐ Alarm (over-temperature, under-temperature)
- ☐ Vapor Control
- ☐ Timing (thermal)
- ☐ Radiant Heat Control
- ☐ Pressure Control (by controlling vapor temperature)

OTHER (Please fill in your special requirements) .....

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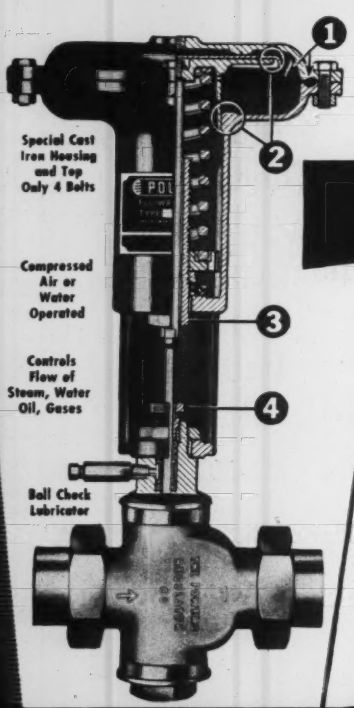

POWERS **LOWRITE** VALVE

★ **VALVE TOP**—Durable moulded neoprene diaphragm (1) has positive sealing bead which provides increased sealing action with increasing control pressure. Efficient diaphragm form insures ample and constant operating power thru full travel. Piston Plate Assembly (2) has a free floating thrust plate which absorbs side thrust. Closely guided piston plate maintains stem in accurate alignment.

★ **ADJUSTING SCREW**—Ball bearing non-rising type. Easily accessible, 180° turning radius with starting pressure adjustable from 0 to 17 psi. Has enclosed rust proofed steel spring for full travel in 5 or 10 psi. control pressure change.

★ **BONNET ASSEMBLY**—Polished stainless steel stem in preformed lubricated metallic packing insures long life and low hysteresis.

VARIETY of VALVE BODIES — Sizes ½" thru 8" — For line pressures below 250 psi. Rugged construction to withstand piping strains. Single seat or double seat, bronze and stainless steel trim. Double unions and flanged ends. Available normally open (direct acting) or normally closed (reverse acting) and 3-way type valves.

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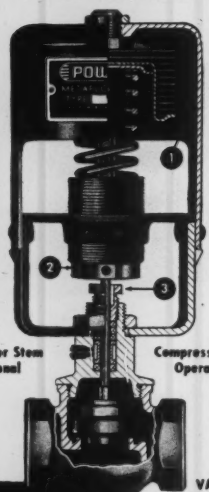

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VALVE SIZES— ½" thru 2"

Bronze bodies, screwed ends. Rugged construction to withstand piping strains.

POWERS *Metaflow Valves* are small, sturdy, light-weight, reasonably priced, suitable for many control applications where the pressure differential does not exceed 75 lbs. per square inch.

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3. **BONNET ASSEMBLY**—Polished stainless steel stem in preformed lubricated metallic packing insures long life and low hysteresis.

TRIM—Composition disc with brass integral seat and self-aligning disc holder. Available normally open (direct acting) or normally closed (reverse acting), and 3-way.

METAFLOW NO-PAK VALVES prevent leakage of inflammable or harmful liquids or gases and provide vacuum protection. Are suitable for use with Freon, oil, gasoline, non-corrosive gases, hot or cold water and low pressure steam.

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The same engineering talent and manufacturing facilities that produced these turbines are available to assist you in obtaining efficient power generation.

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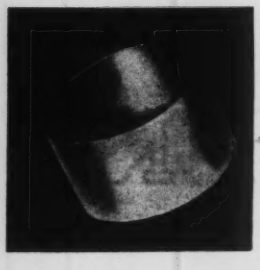

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And here's the payoff: Parts made of Formbrite polish so easily and so quickly that often only a color buff is needed for plating.

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STRAIGHT LINE DRIVES

...for quality... economy... efficiency...

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QUALITY that starts with Duti-Rated, high hardness, precision helical gears, assembled into rugged cast housings of compact, streamlined design.

ECONOMICAL to buy because the latest, most accurate high production machine tools assure rapid production with exceptional accuracy for long wear life. Economical to operate because simplified construction, minimum number of moving parts, direct splash lubrication, quality workmanship—all hold maintenance to a minimum.

EFFICIENCY—Straight line design with Duti-Rated helical gears gives efficiencies of 96%, or higher.

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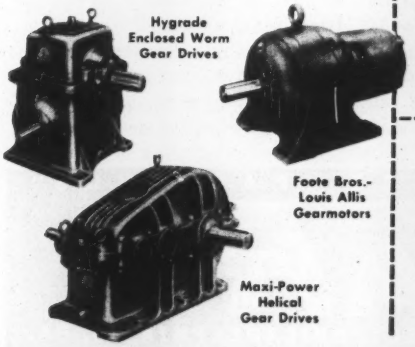

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Foote Bros.-Louis Allis Gearmotors

Maxi-Power Helical Gear Drives

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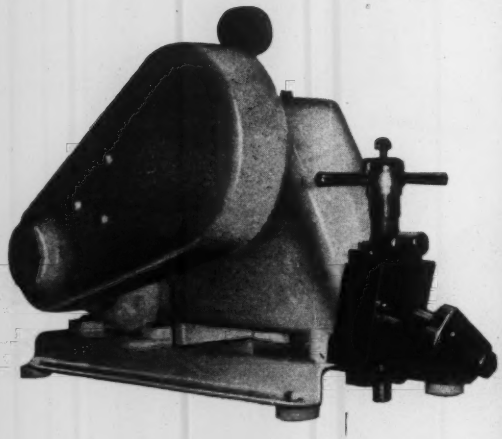

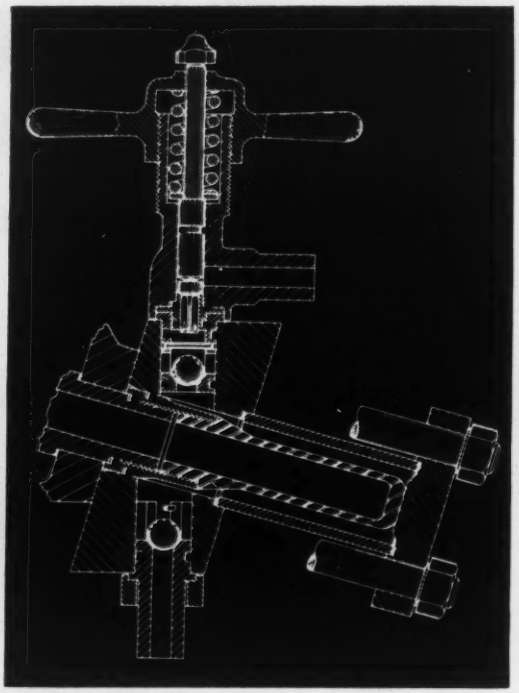

TIP...

FOR THE DESIGNER

Cleaning Made Easy Down-Time Reduced With...

LINEAR "O" RINGS

The slim, compact appearance of the Logeman Hydropulse Homogenizer marks a simplification in design and construction that sets a new high standard for easy maintenance in equipment of this type.

LINEAR "O" Rings greatly simplify the design, reduce bolt stress and enable the pressure heads to be readily disassembled and re-assembled for cleaning purposes. In many processes, this is required several times a day and is accomplished with a minimum of down-time as compared to other type packings. Despite working pressures ranging from 200 to 3000 psi, the seals are fluid and gas tight... no leakage, no seepage, no contamination of product!

LINEAR "O" Rings are compounded of natural or synthetic rubber, fluorethylene polymers, and "Silastics"... are molded in a complete range of J.I.C. and A.N. standard sizes, as well as hundreds of non-standard sizes for special uses.

"PERFECTLY ENGINEERED PACKINGS"

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LINEAR, Inc., STATE ROAD & LEVICK STREET, PHILADELPHIA 35, PA.

The instrument man's "Man Friday"

High-fidelity Foxboro Portable Potentiometer — metal cased and covered

You'll never run out of uses for this rugged, precision portable potentiometer. It's the most indispensable tool in the instrument man's kit! Use it to check overall accuracy of your temperature instruments and thermocouples; as a substitute temperature instrument during emergencies; for exploring temperatures not requiring continuous measurement.

The Foxboro Portable Potentiometer Indicator is accurate to ¼ of 1% of scale. Temperature dial has an extra long (17") scale for close, accurate reading, and *vernier dial* for precise balancing. Supplied with either single or double temperature scales to provide for different types of thermocouples . . . or for use with resistance bulbs. Weighs only 12½ lbs. Rugged metal case-and-cover protects the instrument from rough handling.

Write for detailed information on this outstanding Portable Potentiometer Indicator. **The Foxboro Co., 182 Neponset Ave., Foxboro, Mass., U. S. A.**

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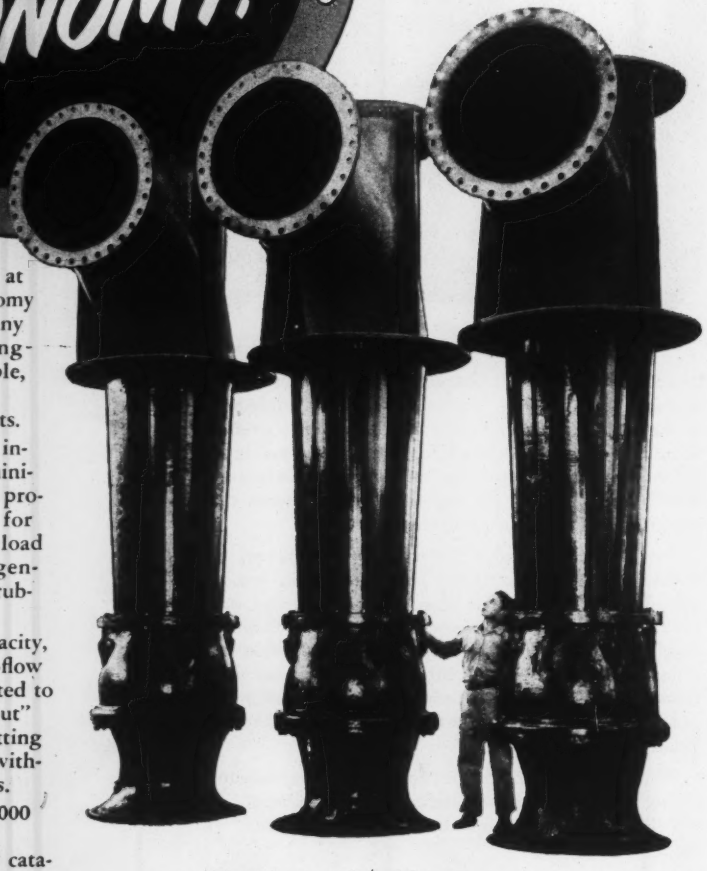
LOOK TO ECONOMY!

Economy mixed-flow pumps, each 28,000 G. P. M., 35-ft. TDH, 575 RPM, for condenser circulation in Georgia public utilities plant.



You can deliver more water, fresh, contaminated or sea, at lower over-all cost, with Economy mixed-flow pumps than with any other type efficient pumping-equipment! Compact and simple, they are designed for large capacity, low head requirements.

Impellers, close to the pump inlet to keep submergence to a minimum, are carefully designed to produce the proper capacities, and for efficient operation during all load requirements. Bearings are generally of the water-lubricated rubber type.

Well suited to any large capacity, low head job, Economy mixed-flow pumps are especially well adapted to condenser circulation. "Pull-out" types are also available, permitting removal of all operating parts without disturbing pipe connections.

Standard sizes range from 1000 to 100,000 G.P.M.; specials to 200,000 G.P.M. For details and catalog No. G-349, write Dept. CM-6.

When it's pumps, think of Economy

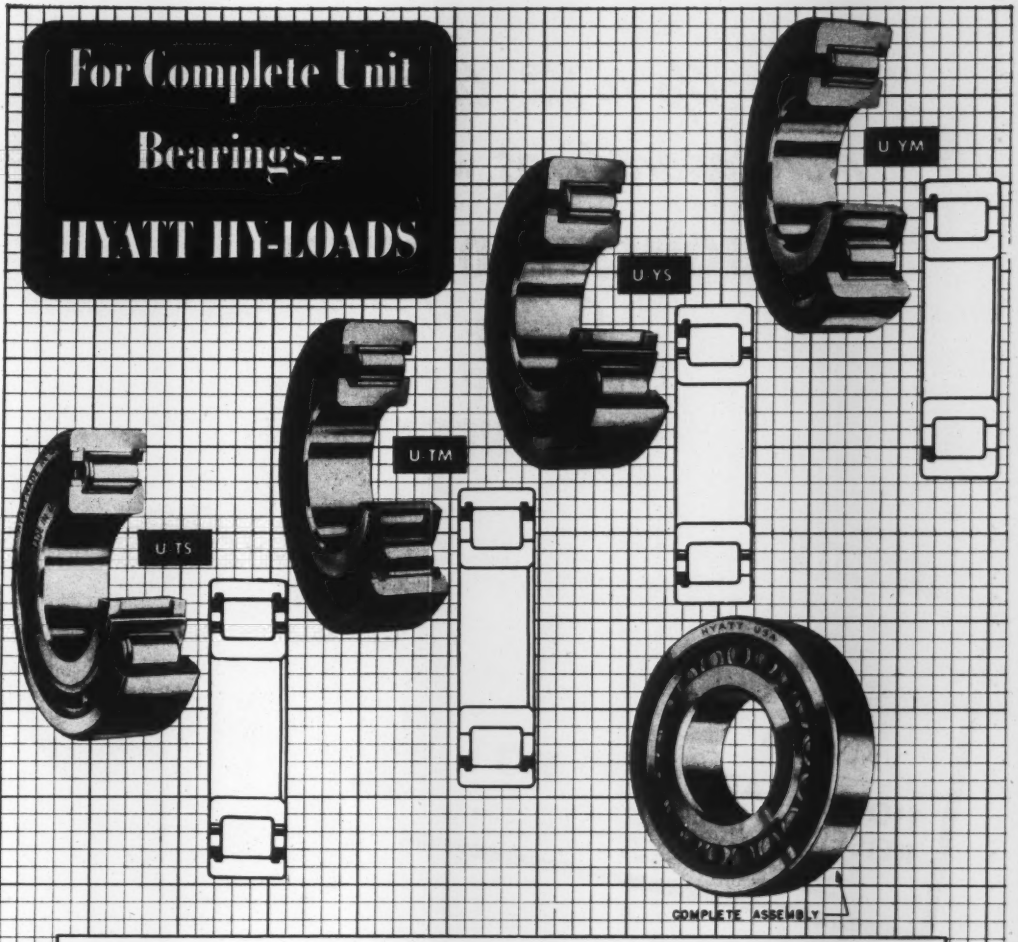
Centrifugal, axial and mixed-flow pumps for all applications.

Economy Pumps, Inc.

DIVISION OF HAMILTON-THOMAS CORP. HAMILTON, OHIO

For Complete Unit Bearings--

HYATT HY-LOADS



IN the Hyatt Hy-Load line of cylindrical roller bearings there are the non-separable types where the rollers, separator and races are assembled into a single unit. They are made for applications where the bearing must be assembled as a complete unit. They also may be used in applications where no shoulder stop is provided to retain the outer race endwise.

Two of these non-separable types are made with cages or separators in which the rollers are pocketed between the inner and outer races. The two other types have a full complement of rollers and therefore are able to carry greater load capacity than is possible with a cage type bearing.

• • •

Complete information about the use of these and all Hyatt Hy-Load Roller Bearings is contained in Catalog 547... a complete engineering guide to radial bearing selection and use. You will find that Hy-Load Bearings with the large selection of bearing types and the wide range of sizes which are made in every type will fit almost any application need. Write for your copy of Catalog 547 today. Hyatt Bearings Division, General Motors Corporation, Harrison, New Jersey.

HYATT ROLLER BEARINGS

Up to 22 times

more operations without re-lubricating

HOMESTEAD-REISER

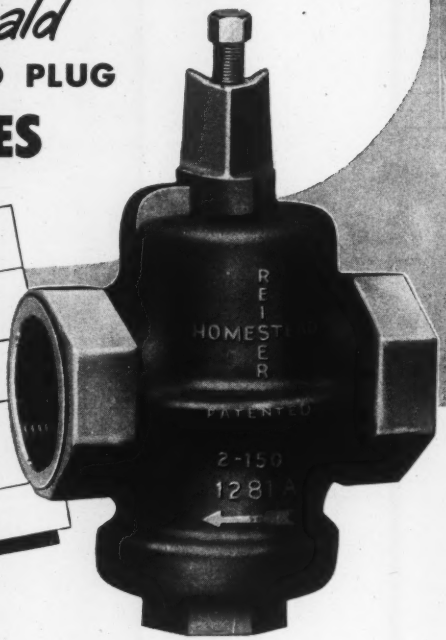
Self-Sealed

LUBRICATED PLUG

VALVES

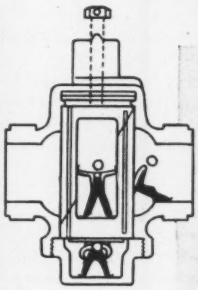
TEST RECORD VALVE	NO. OF OPERATIONS Without RE-LUBRICATING
VALVE "A"	5
VALVE "B"	33
HOMESTEAD-REISER VALVE	110

Each valve assembled with the manufacturer's recommended lubricant. Test made on 75 lb. air pressure.



This comparative test of a Homestead-Reiser Valve and two other well-known lubricated plug valves showed that the Homestead-Reiser Valve remained drop-tight through twenty-two times more operations than Valve "A" without re-lubricating, and through three times as many operations as Valve "B". That means that Homestead-Reisers require less attention, and give greater economy of lubricant.

Prove the superiority of Homestead-Reiser Valves to your own satisfaction, by installing a few in your plant, side by side with any other lubricated plug valve. They may be had in both semi-steel and cast-steel, sizes $\frac{1}{2}$" to 12" for steam working pressures to 150 pounds, or oil-water-gas to 200 pounds.



Write for new catalog 38-5, and for prices on your requirements.

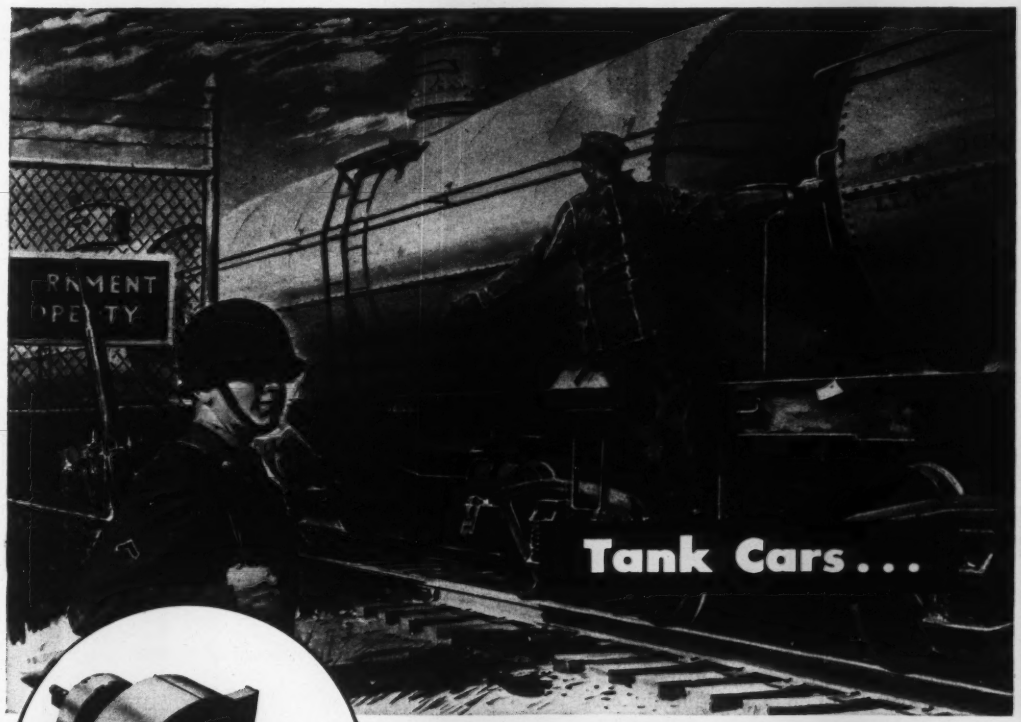
"Self-Seald" MEANS

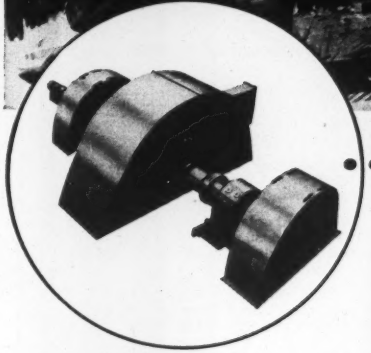
. . . that in addition to a full-port lubricant seal, the wedge-action of the plug under line pressure forces the finished surfaces of the plug outward, and constantly presses them against the seating surfaces of the body, thus keeping them always in intimate contact. The plug automatically adjusts itself for wear, assuring extra long life, maximum leakless service, and lubricant economy.

HOMESTEAD VALVE MANUFACTURING CO.

"Serving Since 1892"

P. O. Box 38 CORAOPOLIS, PA.





. . . or Turbines

. . . no matter what your equipment requirements, efficiency is a must. Always important, this is particularly true now.

In this connection . . . whether it's production, power or processing equipment . . . a progressive equipment builder can recondition old equipment for greater efficiency or, if you're buying new equipment, build it better, saving you money and making most effective use of strategic materials.

Today, such equipment builders achieve these results through *Lukenomics*. For this principle combines their experience, and that of designers and engineers, with Lukens' specialized knowledge of materials and their application. For names of these equipment builders, write, stating your problem, to Manager, Marketing Service, Lukens Steel Company, 402 Lukens Building, Coatesville, Pa.

Reduced maintenance, increased safety, long service life were achieved in this 56,000-HP hydraulic turbine, parts of which are subjected to shock loads from zero to 100,000 lbs. to zero again, five times each second. Design and fabrication ingenuity plus Lukens steel plate components overcame the engineering problems. Thus, the builder efficiently assured long equipment life . . . helped conserve strategic materials. *This is Lukenomics at work.*

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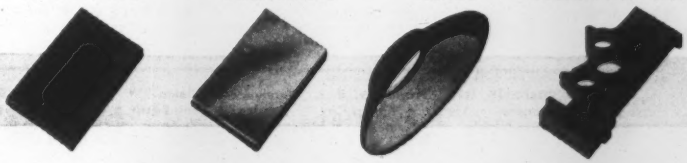

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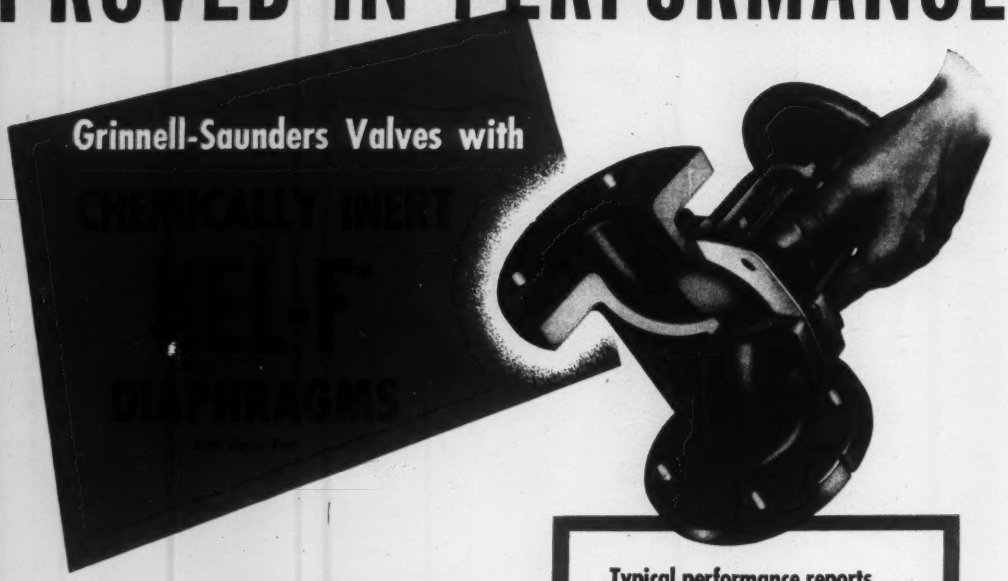

Grinnell-Saunders Diaphragm Valves with KEL-F Diaphragms are living up to every promise made for them! At the right are reports from typical users.

KEL-F's resistance to chemical action, low cold flow, wide range of temperature application and exceptional flex life combine to make it the most important diaphragm development in years. KEL-F is chemically inert to all organic acids and alkalies in all concentrations. It withstands chlorinated aliphatic and aromatic compounds, concentrated nitric, chromic, hydrofluoric and sulphuric acids and most solvents which readily attack rubber and previous synthetic diaphragm materials.

While KEL-F is tough and flexible, it is not resilient. To provide resiliency for proper closure of the valve and to provide added support for the KEL-F diaphragm, it is backed with a rubber cushion. A free-floating method of attachment to the compressor assures an even closing pressure on the entire surface of the weir. A tube nut which floats as the rubber cushion presses down in closing the valve, eliminates excessive pressure on the diaphragm stud. The rubber cushions the closing force, thereby reducing wear and cutting action on the diaphragm. In accelerated tests, a 2-inch valve with a KEL-F diaphragm withstood over 80,000 closures, drop tight, against 80 pounds of air under water with no leakage and no visible signs of wear. Write for complete information.

Typical performance reports . . .

1. Chlorine and HCl gas with small amounts of acetic acid and acetyl chloride at 302° F. for 900 hours. Very much superior to material it replaced.
2. Mixed aromatic and ketone solvents at 230° F. and 10 psi for three months. No sign of deterioration.
3. Chlorinated organic chemical at 158 to 194° F. and 30 to 40 psi for nine months. No failure, no shutdown, no replacement.
4. Chromyl chloride at ambient temperature and 15 psi. Diaphragm condition good at end of thirty days' test.
5. Liquid chloral saturated with HCl at 158° F. for 408 hours. Well satisfied — have placed orders for additional diaphragms.

*"KEL-F" is the registered trade name for polytrifluorochlorethylene, an exceptionally stable thermoplastic. It is produced by the M. W. Kellogg Co.

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GRINNELL COMPANY, INC., Providence, R. I. Warehouses: Atlanta • Billings • Buffalo • Charlotte • Chicago Cleveland • Cranston • Fresno • Kansas City • Houston • Long Beach • Los Angeles • Milwaukee • Minneapolis • New York Oakland • Philadelphia • Pocatello • Sacramento • St. Louis • St. Paul • San Francisco • Seattle • Spokane

Remember the trade marks "tt" and "TUBE-TURN" are applicable only to products of TUBE TURNS, INC.

Make piping permanent and leakproof

Write Dept. F-6 for free booklet listing properties of pipe and welding fitting and flange materials.

PIPING PERMANENCE is always important but now, more than ever, any installation of piping should be leakproof, maintenance-free and have extra long life. A piping system, big or small, is only as strong as its weakest component. That's why welding fittings, for example, should be specified with care.

TUBE-TURN Welding Tees are drawn from seamless tubing to a barrel shape—the shape every tee wants to assume under pressure. This feature, together with the generous crotch radius and thickness, explains why TUBE-TURN Welding Tees withstand more pressure without yielding. Bursting pressures obtained in tests of representative fittings have averaged more than 25% higher than required by standard codes. Here's extra quality at no extra cost.

Get in touch with your nearby TUBE TURNS' Distributor. You'll find one in every principal city.

"Be sure you see the double tt"

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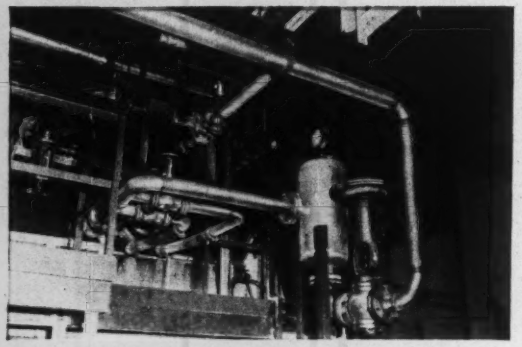
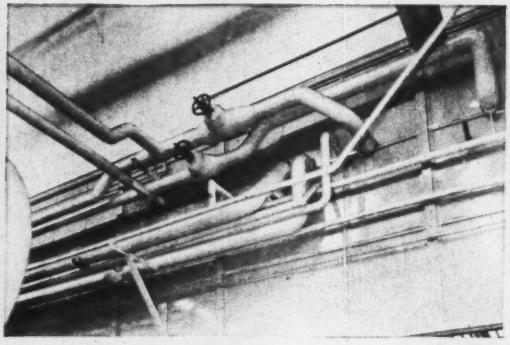
TUBE TURNS OF CANADA LIMITED, CHATHAM, ONTARIO... A wholly owned subsidiary of TUBE TURNS, INC.

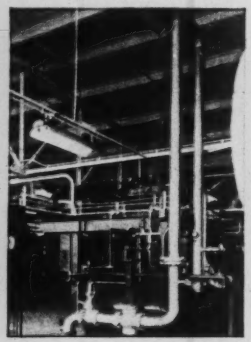
Penicillin processor welds stainless steel piping ½" and up



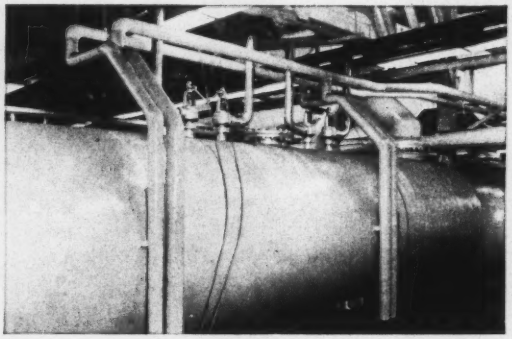
Advanced facilities in plants and laboratories help Eli Lilly and Co., Indianapolis, turn out a high volume of pharmaceuticals, biologicals, and antibiotics. This new filtration unit in the penicillin processing system uses 3" and 4" Type 316 stainless steel—chosen to resist corrosive action. Welded system with TUBE-TURN Welding Fittings and Flanges was chosen to provide maximum strength and eliminate leakage.



Neat appearance of insulated lines demonstrates simplicity of welded piping. Insulation was applied quickly over pipe and TUBE-TURN Welding Fittings, with no awkward joints to work around. Maintenance men know that insulation will last, with no leakage to cause deterioration. Cleanliness and neatness are prime requirements in Eli Lilly plants.



Up in the air goes a loop welded with 6" pipe, joined with TUBE-TURN Welding Fittings and Flanges. Structural strength here is a must. In this fermentation tank where life-saving penicillin is made, tiny lines of ½", as wel. as larger sizes, are welded. Comparable modern facilities are provided for making streptomycin and other products.



Lines to process vessel fit neatly into a small space when TUBE-TURN Welding Elbows make the turns. Eli Lilly engineers specified process piping for optimum flow conditions, compactness, and elimination of leakage.

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Safety is an important consideration in *any* construction operation! That's why dependable TDA Brakes were used on the Cleveland Electric Illuminating Company's specially-built pavement cutter. This unusual machine is used to cut pavement preparatory to trenching operations for underground cables and steam mains. Two slots approximately 2 inches wide and up to 17 inches deep can be cut as fast as five feet per minute! A TDA Duo-Grip Brake is used for emergency purposes and to hold the machine on grades. Simple construction and positive action decrease maintenance—increase performance!

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In this modern age of power and speed, manufacturers have to rely more and more on safe, effective brakes to keep their machines under constant control. And TDA Brakes are filling this need consistently and dependably—even under the most unusual and exacting requirements! These advance-designed brakes are the result of TDA's more than 40 years of braking experience—plus the efforts of highly competent technicians and engineers. If you have a braking problem—regardless of its nature and scope—contact TDA Brake Division! By simply mailing the coupon below you'll find out how you and your product will be repaid.

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THE TIMKEN-DETROIT AXLE COMPANY
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The Accepted TDA Standard

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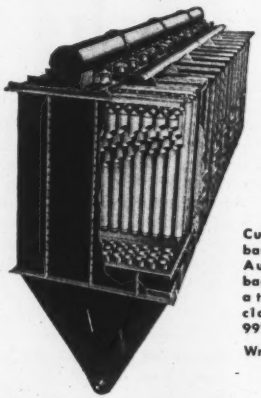
Ninety per cent of the antimony mined in the United States is with Norblo Automatic Bag Type Dust-and-Fume Collectors, at the smelters shown above. Here seven separate Norblo bag houses are used in the roasting, smelting, refining or conversion of antimony, gold and tungsten.

In other smelting fields Norblo is equally outstanding. For example, three out of the four largest modern lead and zinc slag fuming plants in North America have Norblo automatic bag houses.

The heavy duty continuous service Norblo bag type fume and dust collection equipment has made and is still making a most important contribution to national welfare.



Cutaway shows Norblo basic unit of 78 bags. Automatic shaking and bag cleaning, one unit at a time, insures full use of cloth area better than 99% of the time.

Write for Bulletin 164-2

THE NORTHERN BLOWER COMPANY

Engineered Dust Collection Systems for All Industries

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FOR MAXIMUM RESULTS

use these American Standard specifications and procedures for gear design, manufacture, and inspection.

INSPECTION OF FINE PITCH GEARS, B6.11—1951 $2.50

This new American Standard provides the best method for determining before assembly whether or not a mechanism employing gears of 20 diametral pitch and finer will function properly. The slower and more analytical methods of obtaining the same information are described, and their uses and limitations defined. Included are specifications for backlash and tolerances, the procedures for making comparator layouts and photographic negatives to desired scale, requirements for machining gear blanks, gear blank terms, pin measurements, directions for using master gears, and classifications for various degrees of surface roughness, waviness, and for several varieties of lay.

DESIGN FOR FINE-PITCH WORM GEARING, B6.9—1950 $1.50

This is a design procedure for worms and worm gears with axes at right angles, comprising cylindrical worms with helical threads, the worm gear being hobbed for fully conjugate tooth surfaces. It supplies the standard proportions of worms and worm gears, values of diameter for all possible combinations of leads and lead angles within the Standard, and tooth proportions based on normal pitch for all combinations of standard axial pitches and lead angles. An extensive table gives the difference in departure from a straight side of the worm profile and the changes in pressure angle produced by cutters or grinding wheels of 2-in. and 20-in. diameters.

FINE-PITCH STRAIGHT BEVEL GEARS, B6.8—1950 $1.00

This standard covers generated straight bevel gears of 20 diametral pitch and finer, for all shaft angles, and with the numbers of teeth equal to or greater than 16/16, 15/17, 14/20, 13/30 for 90-degree shaft angle. Given in its pages are the general specifications, nomenclature, symbols, the tooth proportions for 1 diametral pitch, gear blank dimensions and tolerances, and the fine pitch straight bevel gear dimensions.

GEAR NOMENCLATURE, B6.10—1950 $1.50

In this standard are listed and defined the 179 terms commonly used in gear engineering. For convenience of users, terms are grouped in sequence to indicate their close relationship. Eighty-six drawings illustrating the terms.

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20-DEGREE INVOLUTE FINE-PITCH SYSTEM FOR SPUR AND HELICAL GEARS, B6.7—1950 $1.50

This fine pitch series includes gears having a 20-degree pressure angle. Tables give standard tooth proportions, tool parts, dimensions of enlarged pinions, gear dimensions, the recommended minimum number of teeth in the gear for the standard center-distance system and the center-distance increase for the enlarged center-distance system. Data show the permissible reduction in outside diameter of gears from 20 to 200 diametral pitch.

While avoidance of pinions having less than 10 teeth is recommended data covering the design of spur and helical pinions having 9, 8 and 7 teeth are given. An appendix provides the formulas used in calculating the values in the various tables. Definitions are included for all symbols used.

LETTER SYMBOLS FOR GEAR ENGINEERING, B6.5—1949 30¢

This system of symbols and subscripts is generally consistent with those appearing in other American Standards, and follows the same general principles. There are over 140 symbols in the collection grouped under two headings—general and special. Other lists indicate: the allocation of the letters of the English alphabet for gear engineering symbols, the Greek letters employed in the standard, and a recommended plan for subscripts.

SPUR GEAR TOOTH FORM, B6.1—1932 55¢

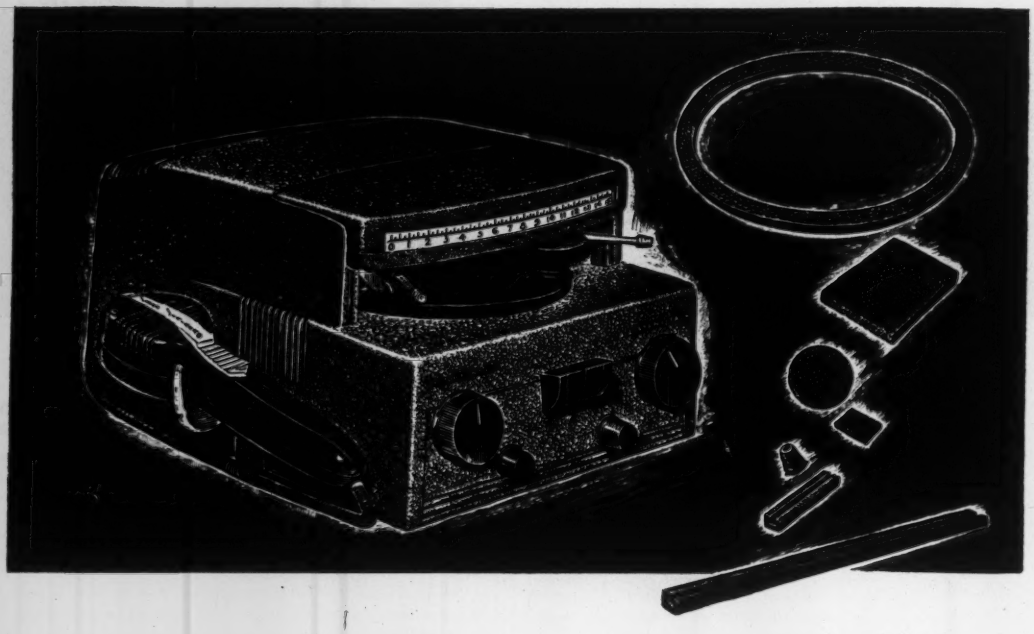
This standard provides the proportions of the American Standard tooth form for 14½ degree composite system, 14½ degree full depth involute system, 20-degree full depth involute system and 20-degree stub involute system. Data are presented for obtaining full involute tooth action on pinions of 31 teeth and smaller when using the 14½ full depth involute system, and on pinions of 17 teeth or smaller when using the 20-degree full depth involute system.

GEAR TOLERANCES AND INSPECTION, B6.6—1946 80¢

These tolerances apply to spur, helical, bevel and hypoid gears. The diameters considered are from 3/4 to 100 inches. The pitches range from 1 to 32 diametral pitch. The fundamental errors for which tolerances are given are defined and explained briefly. Allowances and tolerances for backlash are also treated.

Price of Set of Gear Standards including Binder—$11.25

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS, 29 W. 39 St., New York 18, N. Y.



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CELLULAR RUBBER

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MOTOR SHOCK ABSORBERS — absorb shock in motor suspension and dissipate motor vibration. ***Custom-molded Spongex.***

AMPLIFIER GASKET — protects the amplifier from damage should machine be banged about, as often happens on business trips. ***Custom-molded Spongex.***

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IN THIS new Pressure Vessel Catalog 501 you will find the latest data covering pressure vessel outlets compiled as you would expect it to be by the originators of forged and rolled steel welding necks and nozzles.

The pages include up-to-the-minute information on seamless steel nozzles, welding necks, manways, and large diameter flanges for boilers, heat exchangers, and other pressure vessels. Of particularly timely importance are data covering standards of Tubular Exchangers Manufacturers Association (TEMA Standards). A useful section on modern flange design covers codes, materials, and design procedures with typical calculation forms and examples of calculation.

This 118 page book is available without charge to anyone having a specific interest in outlets for pressure vessels. To obtain your copy see your Taylor Forge Distributor or **MAIL THE COUPON.**

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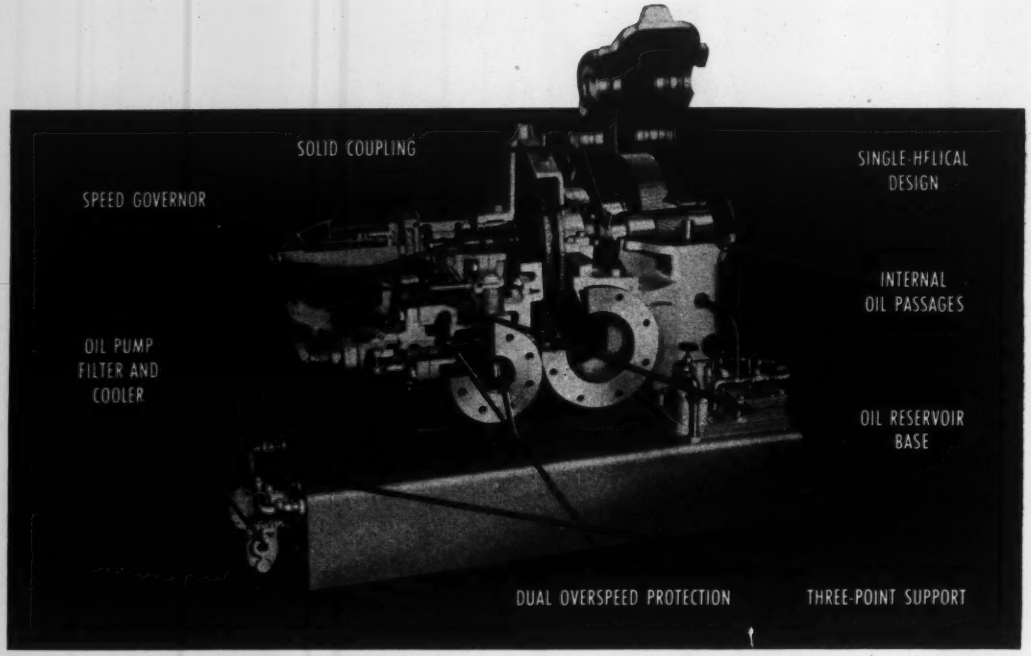

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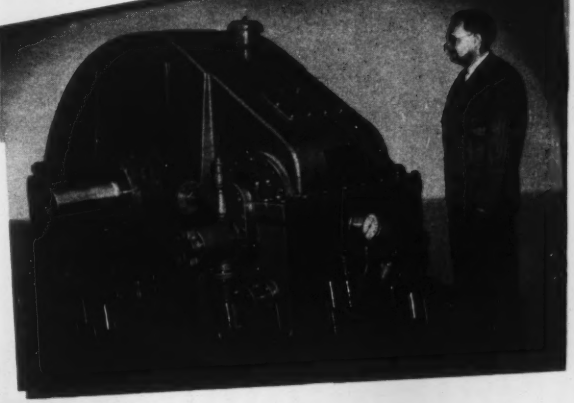

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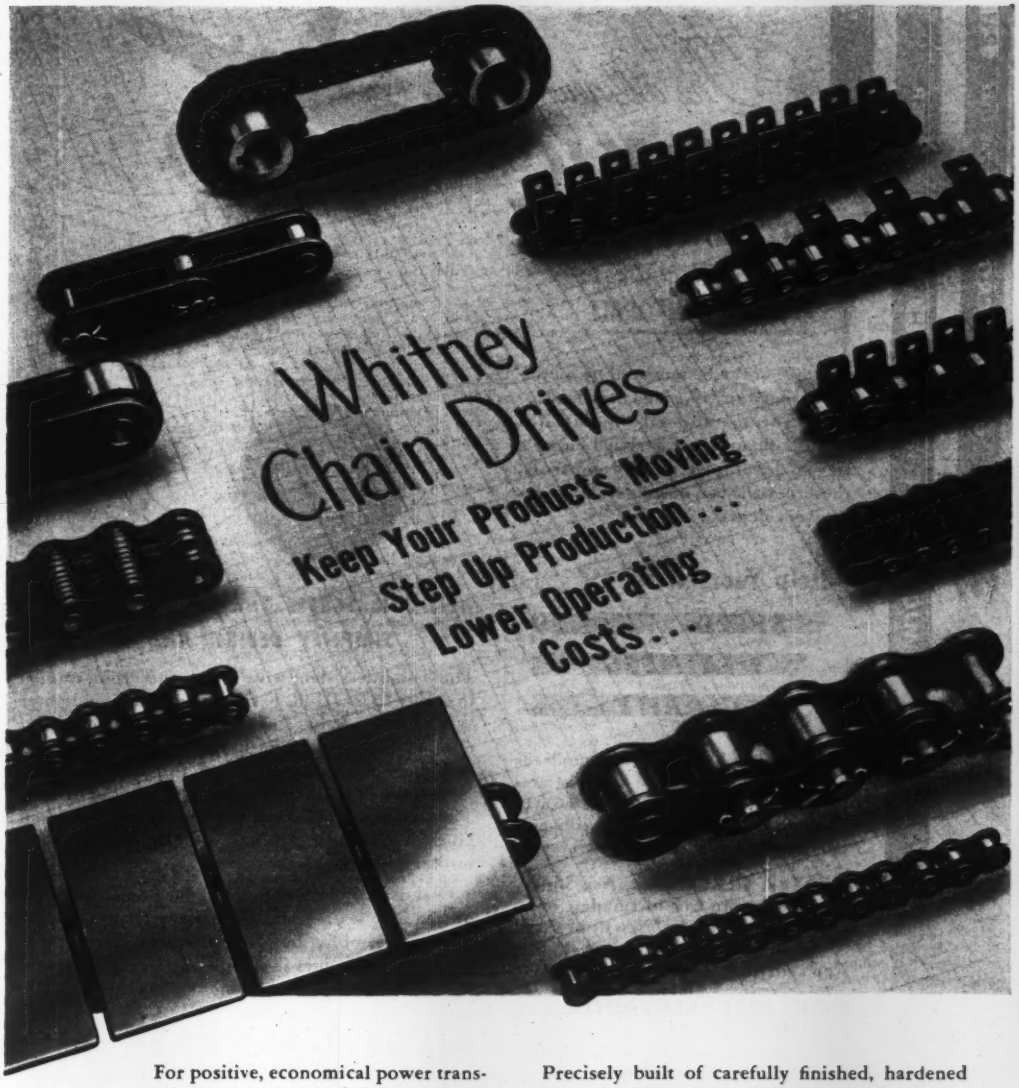

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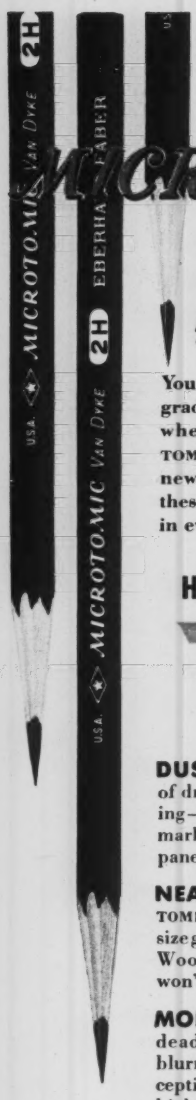

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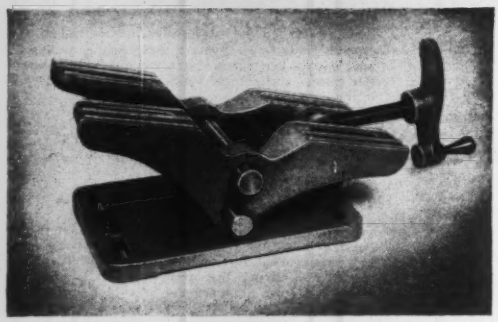

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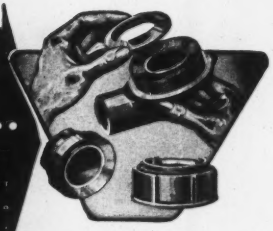

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MECHANICAL ENGINEERING
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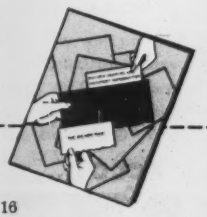

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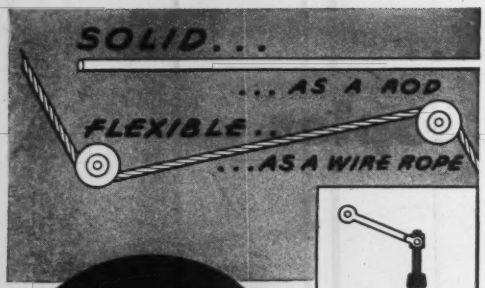

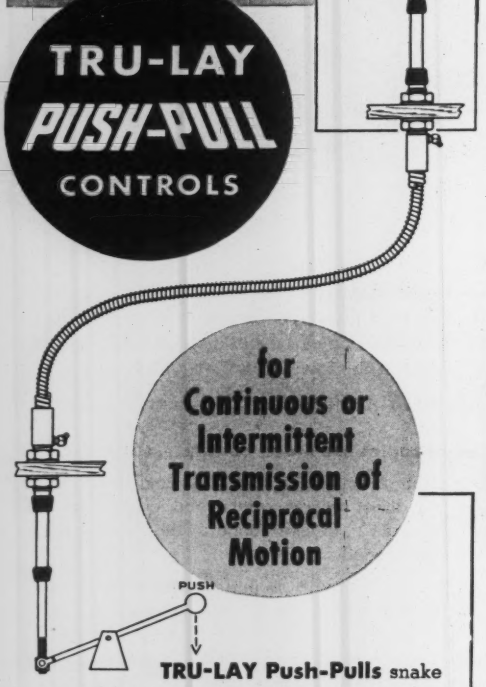

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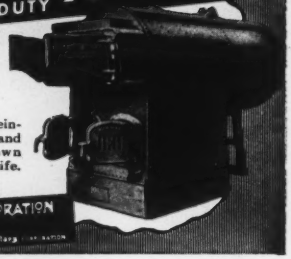

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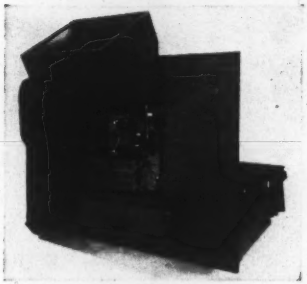

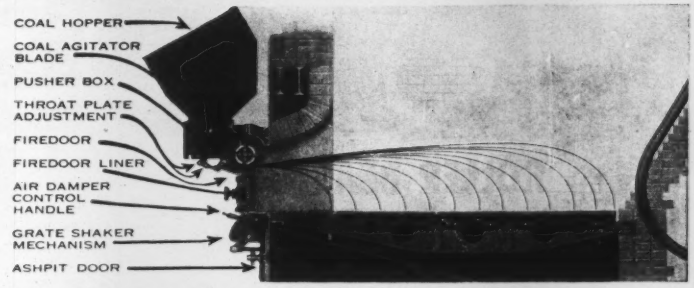

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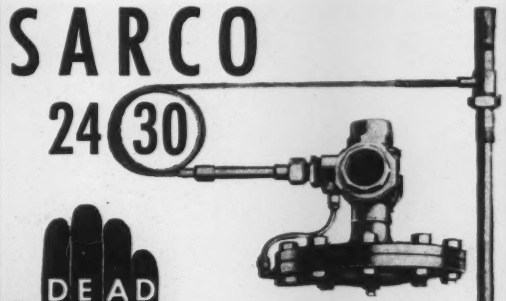

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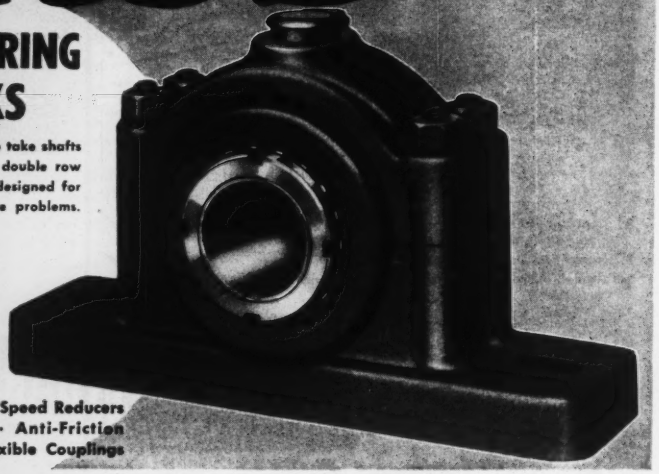

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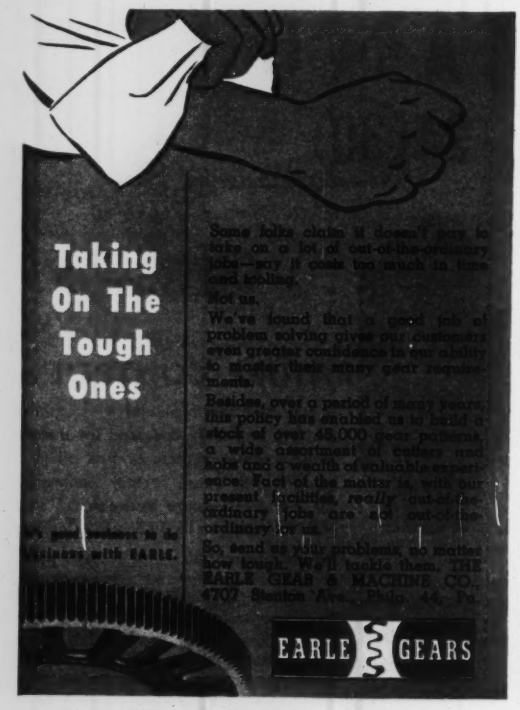

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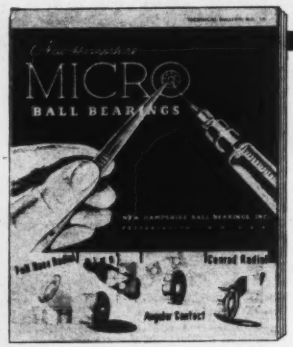

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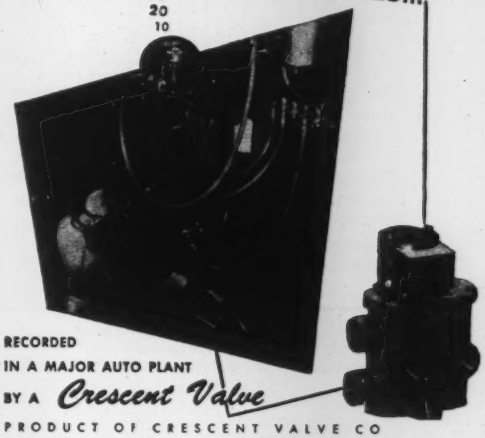

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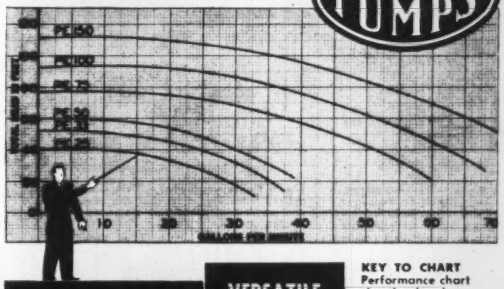

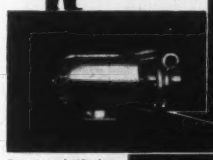

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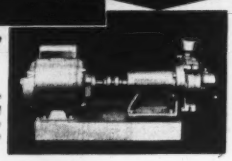

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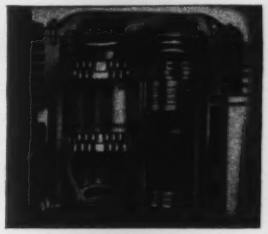

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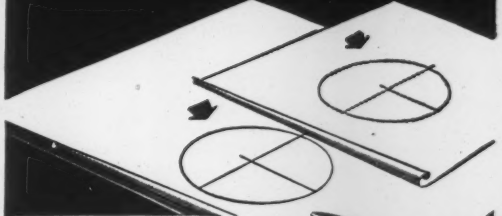

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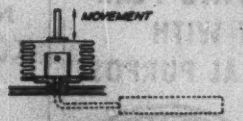

Fig. 1 Thermostatic Motor—This type of assembly is widely used in temperature regulators, etc., where a thermostatic charge is confined in the bellows and where a valve, switch, damper, etc. is to be operated in response to temperature changes.

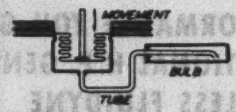

Fig. 2 Thermostatic Motor—This assembly is used where it is desirable to have the thermostatic charge confined outside the bellows and within a cup. May be used with or without remote bulb shown.

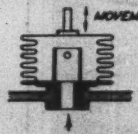

Fig. 3 Pressure Motor—Bellows assemblies are often employed to convert pressure effects into controlled movement. Fig. 3 shows such an assembly where the pressure is applied inside the bellows.

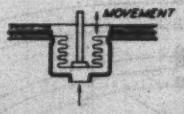

Fig. 4 Pressure Motor—This assembly differs from Fig. 3 in that the pressure is applied outside the bellows and within a cup.

Fig. 5 Expansion Chamber—This type of assembly is employed to absorb thermal or pressure expansion. With suitable heads, it would be used to serve as a reservoir for a liquid or gas. Example: Oil reservoir for electrical cable joint.

Fig. 6 Expansion Joint—Packless and leakless construction for expansion joints used to absorb thermal expansion of pipe lines carrying steam, water, etc. May be used to absorb vibration and provide flexible connection for other applications.

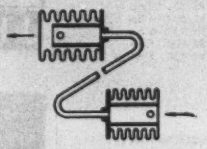

Fig. 7 Motion Transmission—Two bellows assemblies joined by a tube for hydraulic transmission of motion or power. Motive force applied may be either thermostatic or mechanical.

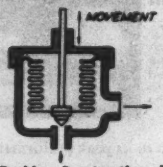

Fig. 8 Packless Construction—Illustrating packless valve construction. Same principle used to seal stem movement or adjustment in many types of apparatus.

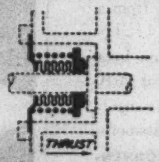

Fig. 9 Shaft Seal—Widely used for refrigeration compressors to prevent leakage around revolving shaft. Spring pressure holds nose of seal against shoulder on shaft. Another type used rotates with shaft and seals against stationary plate.

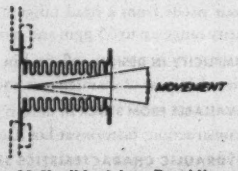

Fig. 10 Flexible Joint—Providing a means to seal a flexible joint or mechanical movement of levers, linkage, etc., against leakage where the movement must be conveyed outside an enclosure. Example: Operating stem of float switches, etc.

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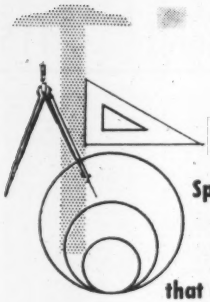

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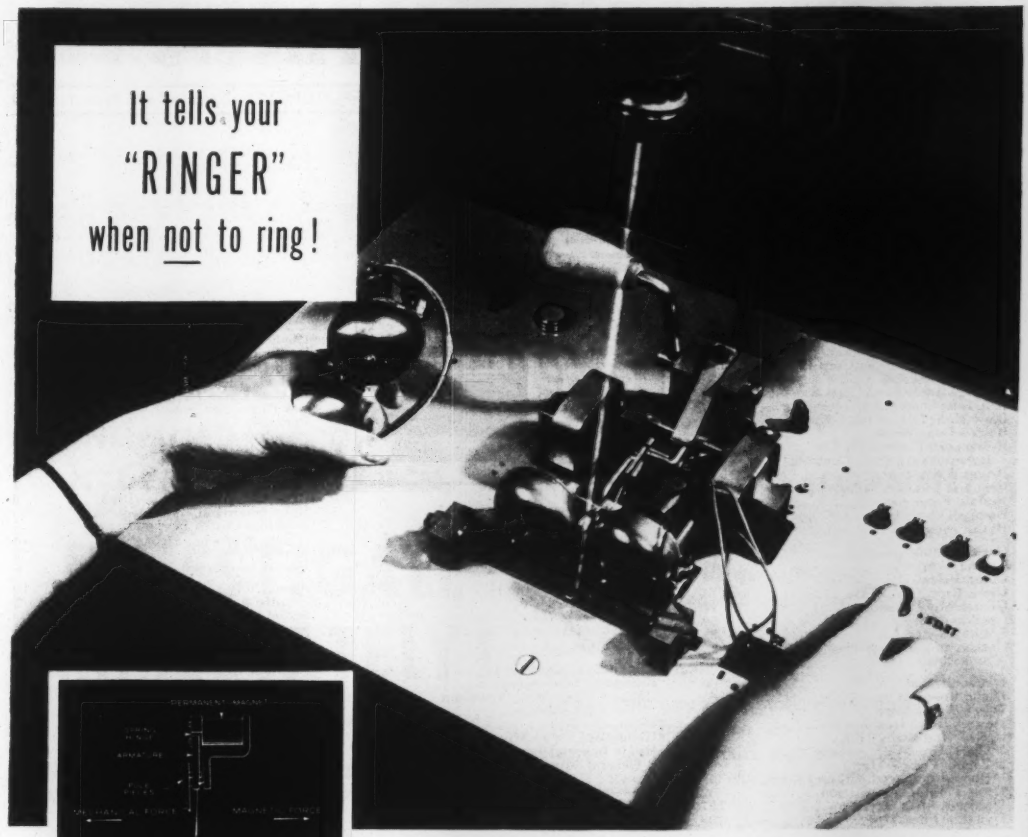

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DRYSEAL-THREAD PRESSURE PLUGS

(SEAL TIGHT WITHOUT SEALING COMPOUND)

Controlled chamfer for quick starting of threads.

Controlled grain structure for stronger threads.

UNBRAKO "Dryseal" Pressure Plugs provide positive sealing even under extreme pressures.

UNBRAKO "Dryseal" Plugs—in a full range of sizes from 1/16" to 1¼" NPTF**—are made from the same high-strength steels and have the same outstanding features found in other UNBRAKO products.

**NPTF is the standard symbol used to designate National Pipe Thread "Fuel."

Available with Dryseal thread up to and including 1¼"

Standard Pipe Size	Threads per inch	Overall Length	Price per 100	Quantity per box	Standard Pipe Size	Threads per inch	Overall Length	Price per 100	Quantity per box
1/16	27	5/16	5.00	100	1/2	14	9/16	13.50	50
1/8	27	3/8	5.50	100	3/4	14	5/8	23.00	50
1/4	18	7/16	7.75	100	1	11½	3/4	36.00	50
3/8	18	1/2	11.00	100	1¼	11½	15/16	75.00	50

Cadmium plating extra. Also furnished in Duralumin, Bronze, Brass, Stainless Steel or any other metal required. Sizes other than listed by special order. Prices on application.

Prices subject to change without notice.

LIST PRICES SUBJECT TO DISCOUNT

SPS

★ One of a series listing *Standard* UNBRAKO Socket Screw Products sold by your local UNBRAKO Distributor. If you want reprints of this and other advertisements in the series, ask for them on your business letterhead.

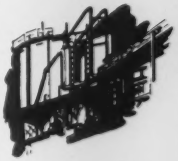
STOP specifying "specials"! LOOK *first* at UNBRAKO *standards!*

PERMUTIT PRODUCTS for POWER PLANTS

ZEO-KARB SOFTENER. The Permutit Zeo-Karb® Softener removes both hardness and bicarbonates from raw water. The effluent is soft and reduced in total solids and alkalinity. Sulphate-carbonate ratio may be adjusted as desired by a system of mixed effluents.

SILICA REMOVAL PLUS DEMINERALIZATION. Demineralization by cold ion exchange processes produces water of comparable quality to distilled water at a fraction of the cost of distillation. Treatment by an anion exchange resin, Permutit S®, reduces silica to less than 0.2 ppm.

DEAERATING HEATER. The Permutit Deaerating Heater, utilizing exhaust or bled steam, prevents corrosion of feed lines, stage heaters, economizers, and boilers by removing oxygen and free CO_2. Capacities from 12,000 to 1,400,000 pounds per hour are in service.



SLUDGE BLANKET HOT LIME SODA. The application of the sludge blanket design to hot lime soda treatment gives you soft water of a low treatment content. **HOT ZEOLITE.** Subsequent treatment by Permutit Q® yields a final zero-hardness effluent.

PRECIPITATOR. The Permutit Precipitator is used to lower alkalinity, reduce hardness, and help to remove turbidity. It can also be used to reduce silica.

• • • • • • • •

These basic processes—plus Permutit skill—can solve your water conditioning problem

Whatever your water treatment problem, Permutit offers all types of equipment and minerals that can supply soft, clear, chemically correct water for your plant. Write for full information to The Permutit Company, ME-6, 330 West 42nd Street, New York 18, N. Y., or to Permutit Company of Canada, Ltd., Montreal.

Permutit®

FOR OVER 38 YEARS

WATER CONDITIONING HEADQUARTERS

New automatic has extra strength . . . extra precision . . . with help of TIMKEN® bearings

DESIGNED for heavy-duty performance, this new Acme-Gridley Single Spindle Automatic Bar Machine maintains its high precision even at the fastest feeds and high spindle speeds at which carbide tools can be safely operated. And one good reason for this strength and accuracy is the Timken® tapered roller bearings on the spindle and in the gear box.

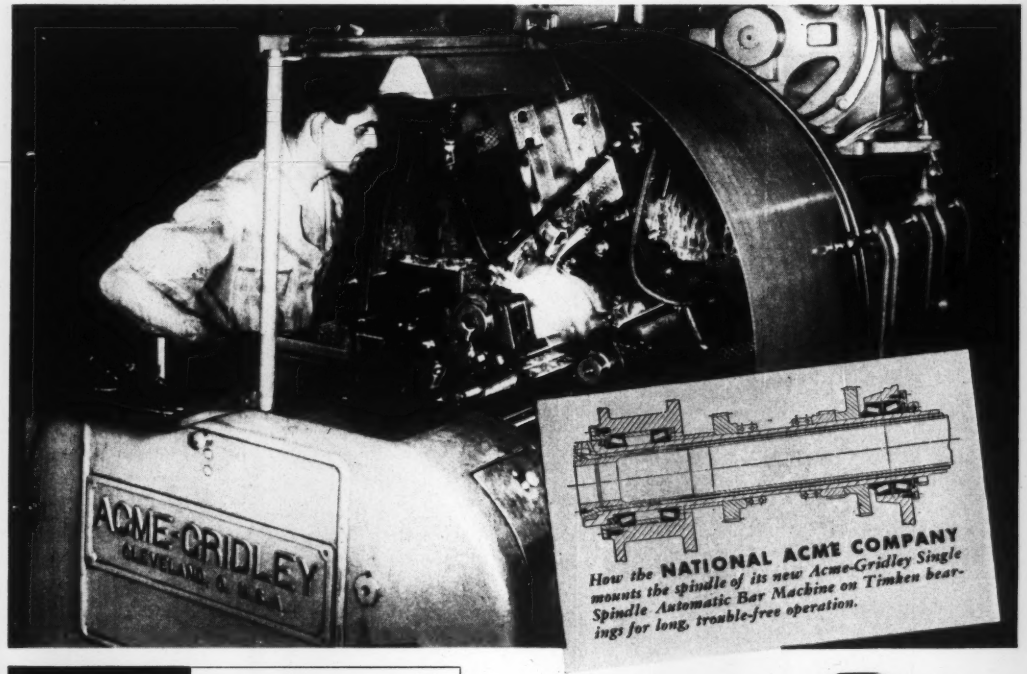
Timken bearings hold the spindle in rigid alignment, yet free to rotate easily. Deflection and end-movement are minimized. Spindle chatter is prevented. And Timken bearings on the first and second intermediate shafts keep gears meshing smoothly, reduce wear on moving parts.

Because of tapered construction, Timken bearings take both radial and thrust loads in any combination. Line contact between rollers and races provides extra load-carrying capacity.

The true rolling motion and incredibly smooth surface finish of Timken bearings practically eliminate friction. Case-carburized, the rollers and races of Timken bearings have a hard, wear-resisting surface and a tough, shock-resisting core. Since Timken bearings are 1) engineered for the job 2) precision manufactured and 3) made of special analysis Timken fine alloy steels, they normally last the life of the machine.

No other bearing can give you *all* the advantages you get with Timken tapered roller bearings. Make sure you have them in every machine tool you build or buy. Look for the trademark "Timken" on every bearing. The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ontario. Cable address: "TIMROSCO".

This symbol on a product means its bearings are the best.



How the **NATIONAL ACME COMPANY** *mounts the spindle of its new Acme-Gridley Single Spindle Automatic Bar Machine on Timken bearings for long, trouble-free operation.*

WE MAKE OUR OWN STEEL

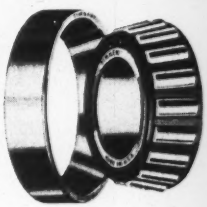
The special grade alloy steel which gives Timken bearings their strength and resistance to wear, is made in our own steel mills.

The Timken Roller Bearing Company is the acknowledged leader in: 1. advanced design; 2. precision manufacturing; 3. rigid quality control; 4. special analysis steels.

TIMKEN

TRADE-MARK REG. U.S. PAT. OFF.

TAPERED ROLLER BEARINGS



NOT JUST A BALL ○ NOT JUST A ROLLER ▭ THE TIMKEN TAPERED ROLLER ▭ BEARING TAKES RADIAL ◫ AND THRUST →◫← LOADS OR ANY COMBINATION →✳←